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THE APPEARANCE of the first issue of THE REFINER AND NATURAL GASOLINE MANUFACTURER last month was welcomed in a way that has caused its publishers much pleasure.

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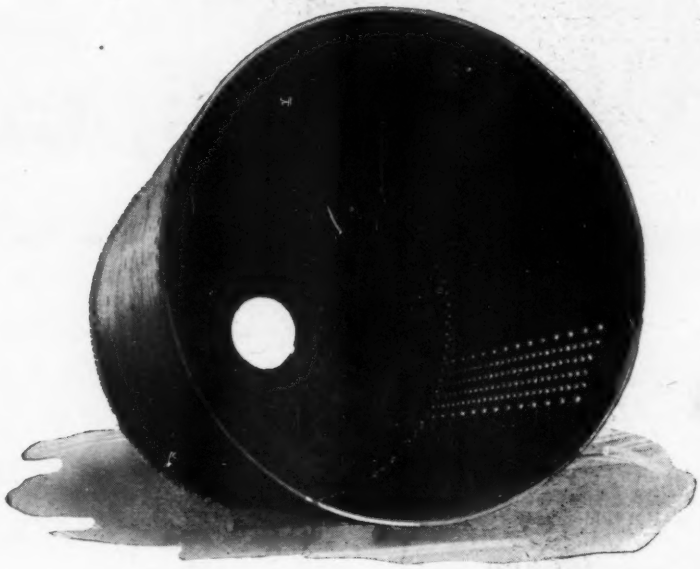

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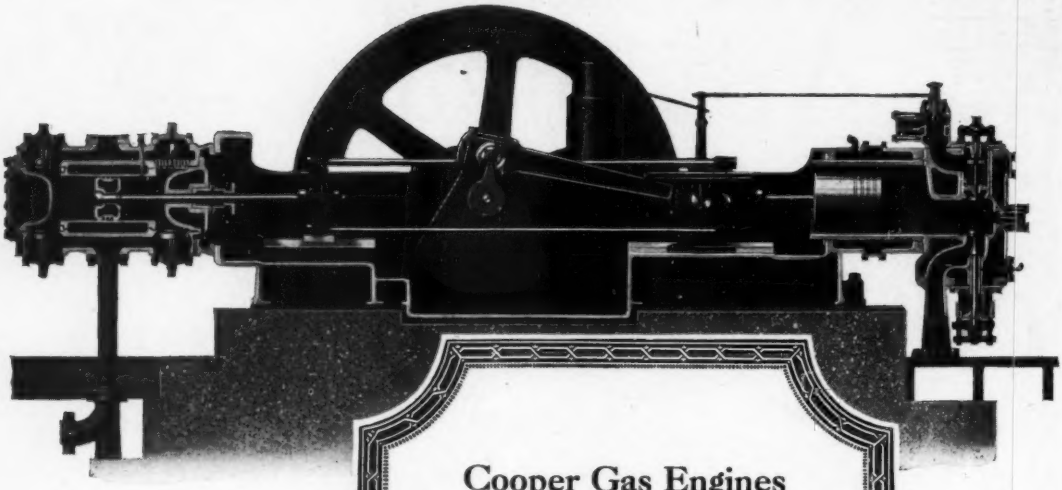

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Gum-Forming Constituents Found in Gasoline

Quantities of gummy substance contained in products that at first appear normal

By N. A. C. Smith and M. B. Cooke

One of the most important considerations in any manufacturing industry is the production of stable material, that is, material which will not change in quality before it reaches the consumer. The manufacturer of gasoline, the refiner of crude petroleum, is handicapped in this respect by the varying nature of his raw material, but as far as it is commercially practicable, he has endeavored to improve his product, and in most cases he has been eminently successful.

It sometimes happens, however, that a gasoline that is apparently normal when first made, will in time deposit small quantities of a gummy substance. The present investigation was undertaken in the hope that it would throw some light on these gums and indicate how their formation might be prevented.

During the early days of the automotive industry gasoline was a mixture of very volatile hydrocarbons. It was distilled from crude petroleum, most of it from Pennsylvania and other "paraffin base" crudes, and was thoroughly refined by redistillation and by chemical treatment. As a result it was water-white in color, sweet in odor, and showed no tendency toward gum formation. The end point of its distillation range was seldom above 300° F., and when evaporated it left no oily or sticky residue. The demand for gasoline, however, particularly in the last six or eight years, has forced refiners to raise the distillation range of their product, but this product is satisfactory on account of the increase in the use of natural gas gasoline for blending and the improvements in the design of engines and carburetors. In 1913 the Burton process for making gasoline by cracking gas oil was developed to a commercial stage. This process and other cracking processes have been used increasingly, until today possibly 20 per cent of the total gasoline supply in the United States is made by cracking heavy oils.

The chemistry of pyrolysis, or cracking by means of heat, has been studied in considerable detail and is known to be essentially the breaking down of high-boiling hydrocarbons into hydrocarbons of lower boiling point. From a study of molecular structure it is evident that this change must result in an increase in the degree of unsaturation of the hydrocarbon material or in a separation of carbon, or both. Assume that we have present a straight chain hydrocarbon of the formula $C_{20}H_{42}$, a saturated compound. If by a cracking process we split this compound in the middle, we can have two molecules each containing ten carbon atoms ($C_{10}H_{22}$ and $C_{10}H_{20}$). Only one of these hydrocarbons, however, is saturated, the other being probably an olefin. It is also possible to split the original molecule into two saturated hydrocarbons ($C_{10}H_{22}$ and C_9H_{20}) if we assume that one atom of carbon is set free. These examples are intended merely to show something of the mechanism of cracking. The oils actually used in commercial processes and the resulting gasoline are all extremely complex mixtures of saturated, unsaturated, and cyclic hydrocarbons, together with small amounts of oxygen and sulphur derivatives.

When cracked gasoline was first placed on the market it met with much opposition, part at least of which was due to lack of experience with the product. It was soon found that cracked gasoline, particularly if made carelessly, has a tendency to deposit gummy and resinous substances in storage, and in some cases in actual use in the engine. This phenomenon has usually been attributed to polymerization of the unsaturated hydrocarbons present. One theory is that the olefins themselves will not form gums, but that the latter are due to the presence of diolefins.

Information has been notably lacking as to the nature, origin, and method of formation of these gummy substances. Some of the questions asked about them follow: Are the gums all of the same character? Are they similar to the coumarone resins, or are they possibly allied to the resins of commerce, which are derived from the terpenes? How should the amount of gum in a given sample of gasoline be determined? How much, if any, gum is permissible in motor gasoline; how much in aviation gasoline?

Copper-Dish Test.

The aeronautical engineers answered the last question during the war. They set zero as the limit for gum in aviation gasoline. To insure this absence of gum they devised the copper-dish test, consisting essentially of evaporating 100 c. c. of gasoline to dryness in a copper dish as quickly as possible on a steam bath. Incidentally, this method also served to detect corrosive compounds, and was very useful in testing gasoline for aviation.

The Bureau of Mines began the present study by investigating the suitability of the copper-dish method for testing motor gasoline. The 850 samples collected during the 1919 gasoline survey* were tested by this method, the results showing very clearly that a great many factors were involved. The presence of corrosive substances and of high boiling material, particularly, interfered with the correct interpretation of the results.

Preliminary Experiments.

The gum as ordinarily developed in the copper-dish test is apparently jet black. One sample, however, of cracked gasoline was found during the 1919 survey which gave a very light colored gum. This suggested that the color of the gum might be due in part to the presence of copper sulphide, and that evaporation in porcelain or glass would be more satisfactory. Gasoline that is evaporating in porcelain has, however, a tendency to crawl up the sides of the evaporating dish, and as it happened that no glass evaporating dishes were immediately available at the time of the experiment, 100 c. c. samples of cracked gasoline were evaporated in 250 c. c. Pyrex beakers. Previous experience had shown that some difference in the amount of gum could be obtained by evaporating at different rates. Accordingly, two beakers containing identical samples of gasoline were placed in an actively boiling steam bath so that the steam came into contact with the entire surface of the beakers; two beakers were placed in one-inch openings in the steam bath so that evaporation was relatively slow. The samples that were evaporated rapidly developed only 11 milligrams; the sam-

* Mr. Smith is a petroleum chemist of the Bureau of Mines while Mr. Cooke is assistant refinery engineer of the Bureau.

*H. H. Hill and E. W. Dean—Quality of gasoline marketed in the United States, Bureau of Mines, Bull. 191, 1920.

ples that were evaporated slowly developed 100 milligrams of gum, a surprisingly large amount. Following the suggestion that speed of evaporation was important, further samples were evaporated in Erlenmeyer flasks, and as much as one gram of gum was produced from each. Finally, a sample in an Erlenmeyer flask was heated under a reflux condenser with a slow stream of air passing through the gasoline for a number of days; it was then evaporated to dryness, yielding about four grams of gum.

This work was carried on at the Washington laboratory of the Bureau of Mines during the summer when the humidity was extremely high. Consequently, water continually collected in the interior of the reflux condenser used, and before the end of the experiment a small amount of water had collected in the interior of the flask itself.

To study the effect of water, identical samples were placed in Erlenmeyer flasks fitted with reflux condensers. In one flask 10 c. c. of water was placed; the other was protected from the moisture in the atmosphere by a calcium chloride tube. Both flasks were heated for 100 hours on a steam bath. The wet sample deposited 0.45 per cent of gum in the flask. On evaporating the residual gasoline at the end of the run, 0.65 per cent more gum was obtained, a total of 1.10 per cent. The dry sample did not deposit any gum in the flask, but the evaporation test at the end of the run gave 1.20 per cent, showing that the actual quantity of gum formed in the two flasks was approximately the same, but that the presence of water seemed to be necessary to cause the gum actually to deposit.

To study the effect of air, two other samples of the same gasoline were then heated for 100 hours in flasks with reflux condensers, both with water present. Through one of them a slow current of air was passed; through the other a slow current of hydrogen. The sample through which the air was passed deposited 3.24 per cent of gum, and on evaporation at the end of the run gave 3.39 per cent of gum in addition, a total of 6.63 per cent. The sample through which hydrogen was passed, which was heated the same length of time under the same conditions, deposited only 0.17 per cent of gum and on evaporation showed only 0.51 per cent, a total of 0.68 per cent, about 10 per cent as much as in the sample through which air was passed. It has since been shown that these gums dry very slowly and require several days, sometimes weeks, to come to constant weight in an oven at 105°C., hence the above-mentioned results are probably somewhat in error. The large differences obtained by the use of air and hydrogen show, however, that the formation of gum is probably due to oxidation.

"Unsaturation" and Gum-forming

The amount of unsaturated hydrocarbons present in a sample of gasoline is usually estimated* by determining the solubility of the gasoline in concentrated sulphuric acid. In order to ascertain if the amount of gum that could be made from a sample of gasoline had any relation to the "unsaturation," as so determined, a sample of the above gasoline was heated for 100 hours in the presence of water, with a current of air passing through it. At the end of this time the sample was decanted from the separated gum and then distilled in a current of "open" steam so that any gum that had formed in the gasoline itself could be recovered. The distillate from the steam distillation was again oxidized in the presence of water for 100 hours, and this process was repeated until more than 7 per cent of gum had been obtained. The "unsaturation" of the original gasoline was 18 per cent; the "unsaturation" of the gasoline from which 7 per cent of gum had been made was 17 per cent. This result indicates that there can be no quantitative relation between the so-called "unsaturation," as measured by solubility in sulphuric acid, and the amount of gum that can be made. To check this point, two samples of gasoline were prepared. One sample was a distillate boiling between 140 (284°F) and 170°C 338° F). This product was thoroughly treated with acid and alkali, and after being thoroughly washed it was steam distilled over caustic potash. It was an absolutely water-white product with an entirely sweet odor. The "unsaturation" was less than 1 per cent. The second sample was prepared by steam stilling cracked gasoline over caustic potash. This sample had an "unsaturation" of 18 per cent. Each of these samples was oxidized by heating under a reflux condenser on a steam bath with a gentle current of air for 300 hours. The cracked gasoline which originally had 18 per cent of "unsaturation" developed 4.14 per cent of gum, and the "unsaturation" of the residual gasoline was still 18 per cent. The saturated gasoline developed 0.97 per cent of gum, and in the process developed an "unsaturation" of 8 per cent.

These figures confirm those reported above, that there is no direct connection between "unsaturation" as determined by solubility in sulphuric acid, and the percentage of gum that can be found from gasoline. It should be noted, however, that the authors have not attempted to measure the amount or kind of "unsaturated" hydrocarbons present in gasoline. The sulphuric acid test is empirical and may indicate the presence of many compounds other than "unsaturated" hydrocarbons.

As stated above, little information is available as to the nature of the gums that form in cracked gasoline. The gums made by oxidation are similar in appearance to those formed spontaneously, but it was thought advisable to apply the information obtained from the foregoing experiments to a study of the gums that develop spontaneously when cracked gasoline is stored.

Gasoline Studied by Gum Tests.

The following four gasolines were selected for the present series of tests:

1. A sample of straight-run treated naphtha ogtained from a small refinery located in Pittsburgh, Pa. This naphtha was selected as being practically free from gum and unsaturated hydrocarbons.
2. A sample of motor gasoline commonly sold in Pittsburgh, which was selected as a representative of commercial gasoline.
3. A sample of cracked gasoline made by an experimental vaporphase cracking process. This was known to be a heavily cracked gasoline and one that was certain to develop gum.
4. A sample of untreated cracked distillate made by one of the large refineries. This was selected as representing the unfinished material from which a large part of our gasoline is made.

The distillation ranges and other characteristics of these samples are given in table 1.

TABLE 1.

Analysis of Four Gasolines Tested

Sample No.	1	2	3	4
Sp. Gr. @ Co° F	0.743	0.742	0.806	0.775
Degrees A. P. I.	58.9	59.2	44.1	51.0
Unsaturation	2.0%	2.5%	23.0%	11.0%
Doctor test	+	+	+	+
Gum glass Dish method Mg per 100 c c	5	5	2,030	21

Distillation 100 c. c. Engler Flask.

Sample No.	1		2		3		4	
Mark	°C	°F	°C	°F	°C	°F	°C	°F
First drop	66	151	46	115	56	133	34	93
10 per cent	101	214	86	187	83	181	96	205
20 per cent	113	235	100	212	93	199	130	266
30 per cent	123	253	111	232	103	217	153	307
40 per cent	132	270	120	248	111	232	172	342
50 per cent	141	286	129	284	119	246	187	369
60 per cent	149	300	138	280	130	266	201	394
70 per cent	161	322	148	298	141	286	212	414
80 per cent	172	342	160	320	159	318	224	435
90 per cent	188	370	180	356	182	360	240	464
End point	208	406	219	426	201	394	260	500
Av. boiling pt.	141°C		131°C		125°C		174°C	
Recovery, per cent	97.0		97.5		96.0		95.5	
Residue, per cent	1.4		1.5		2.1		1.5	
Loss, per cent	1.6		1.0		1.9		3.0	

Development of Analytical Method

Before attacking the main problem it was necessary to study methods for estimating the amount of gum-forming compounds in samples of gasoline. Some of the limitations of the copper-dish method have been stated. Preliminary work indicated two methods as being probably reliable; evaporation under reduced pressure; and distillation by means of open steam. The first method consists of evaporating a measured volume of the sample under reduced pressure to dryness at as low a temperature as possible. The residual gum is taken up in acetone, transferred to a tared dish, and dried in an air oven to constant weight at a temperature of 105° C. The second method consists of steam distilling a measured volume of the sample until no more gasoline can be driven over. The residue, together with the condensed water is then transferred to a tared dish and dried as in the first method.

A study of these methods showed that both gave reproducible results, and also

* Methods for testing petroleum products. Bureau of Mines Tech. Paper 398. 1922. Method 550.1, p. 55.

that the methods checked each other very closely.

As considerable time is necessary to complete an analysis, it was deemed advisable to develop a more rapid method. Accordingly, the effects of several variations on the evaporation of the sample at atmospheric pressure were studied. Glass, porcelain, and fused silica receptacles of various shapes and dimensions were used. The shape of the receptacle, as well as the relative surface exposure of the sample proved to have marked effects on the amount of gum obtained. Glass beakers of several sizes were tried, but very poor checks resulted, the accuracy apparently depending somewhat on the nature of the gasoline under test, as well as on the type of gum present. Glass evaporating dishes of 100 c. c. capacity gave high results, especially in the case of a heavily cracked gasoline, possibly on account of the large surface exposed to the air during the evaporation, resulting in oxidation. Porcelain and fused silica were found unsatisfactory, owing to the creeping of the sample over the edge of the dish during the evaporation. The results showed, however, that fairly good checks were obtained, when small dishes were used in each case.

Method Adopted.

A glass evaporating dish of 30 c. c. capacity was finally adopted as giving the best results as to accuracy and speed of evaporation. Table 2 gives the data collected. It will be seen that the time required to dry samples to constant weight varies according to the percentage of gum present. Gasoline No. 3 carries a high percentage of gum and requires about twice as long to come to constant weight as do No. 1 and No. 2.

The method adopted involves evaporating a 20 c. c. sample of gasoline in a 30 c. c. glass evaporating dish on an actively boiling steam bath for four hours, and completing the drying of the gum by heating for 24 hours in an air oven at 105°C. The dishes used are a commercial product and can be conveniently obtained at small cost from most technical supply houses.

Examination of Gum Isolated.

During the preceding tests it was noted that the gum as first formed was soft and sticky. As it was heated it became harder, and on prolonged drying it became a hard brittle resin. This hard resin was only partly soluble in acetone, whereas the soft gum was entirely soluble. These phenomena suggested those reported by Dr. Baekeland in his work on synthetic resins such as Bakelite. This is a formaldehydephenol condensation product made by heating an aqueous solution of formaldehyde and phenol in the presence of a compound capable of reacting to give off a strong base, sodium acetate, for example. Bakelite is not easily analyzed. Dr. Baekeland* in 1909 also reported that he had succeeded in synthesizing a resin comparable to his Bakelite that was capable of being easily analyzed. An ultimate analysis of his synthetic compound showed that the proportions of raw material used had very little bearing on the final composition of the resin so produced.

The resin isolated by the authors from gasoline was analyzed and the results are given in Table 3, together with those reported by Baekeland. The analyses of Baekeland's synthetic resins and of the resins isolated from gasoline were so similar that a further study seemed desirable. The compounds responsible for the resin formation, following this analogy, would be aldehydes and phenols, or closely related bodies.

Detection of Gum-Forming Compounds.

Qualitative tests were made on the series of four gasolines for aldehydes. Allen** states that aldehydes, especially acctaldehyde, can be detected conveniently by the ammonio-silver nitrate test. This reagent is made by mixing equal volumes of 10 per cent $AgNO_3$ and 10 per cent NaOH, and then adding NH_4OH until the precipitated silver oxide is dissolved. The reagent is added to the liquid to be tested; if aldehyde is present, a silver mirror will be deposited. A liquid containing 1 per cent aldehyde shows a mirror instantly; a liquid containing one part in 1,000 parts shows up in one-half minute; and a liquid showing one part in 10,000 parts, in five minutes. The test was applied both to the gasoline direct and to water extracts of the same. Aldehydes were indicated in all four samples, gasoline No. 3 giving a mirror instantly, No. 4 in one-half minute, and Nos. 1 and 2 only after a half-hour. Thus the amounts of aldehyde present were roughly proportional to the per cent of unsaturation and to the gum formed on evaporation. The Hehner test, which is also recommended by Allen***, gave results of the same order. This test consists of adding a trace of phenol to the aqueous liquid to be tested, and pouring the mixture upon concentrated sulphuric acid, a crimson color indicating aldehydes.

Several tests were also applied for the detection of phenols and phenolic bodies, but in no test was there a positive reaction. This result caused the abandonment of the original conception of the constitution of the gums as phenolaldehyde condensation products, and the possibility of aldehydes alone forming gums was accordingly studied.

Samples of several aldehydes were evaporated in the glass dishes above described, and they gave at most only traces of gum. When a trace of sulphuric acid was present, they gave considerable quantities of gums similar in appearance to those deposited by gasoline. Furthermore, when an aldehyde was added to gasoline that was practically free from gum, and the mixture was evaporated, a considerable quantity of gum was formed.

During storage tests, to be described

TABLE 3.
Comparative Composition of "Bakelite" and Gasoline Gum.

Sample—	Sample 1	Sample 2	Sample 3				
			*Bakelite—formed by				
			1	2	3	4	5
	Resin (soluble in acetone) from gasoline No. 4	Resin (insoluble in acetone) from gasoline No. 4.	1 mol CH_2O, 6 saliginen	1 CH_2O, 4 saliginen	13 CH_2O, 12 saliginen	1 phenol, 1 CH_2O, 1% NH_3	10 cc. phenol, 10 cc. 40% CH_2O, ¼% NH_3
% Ash	2.78	1.00					
Hydrogen	7.39	6.75	5.96	5.44	5.97	5.60	5.71
Carbon	69.48	70.62	77.48	76.47	76.59	77.48	77.92
Nitrogen	0.14	0.07	....	....	....	....	....
Oxygen	19,93	21.06	16.56	18.09	17.44	16.92	16.37
Sulphur	0.28	0.50	....	....	....	....	....

* Baekeland regards "Bakelite" as a polymerized oxybensyl-methylen glycol anhydride, which if made from ordinary phenol might be regarded as $N(C_{43}H_{38}O_7)$.
For analysis see Baekeland, Jour. Ind. and Eng. Chem., Vol. 1, 1909, pp. 149-161.

Table 2
Amount of Gum Found in Gasoline When Evaporated in Various Receptacles

Gasoline No.	Gum shown by vacuum evaporation of 100 c. c. sample Milligrams.	Receptacle used in test Kind	Total capacity c. c.	Sample taken for evaporation c. c.	Time of heating at 100 105°C. to constant hours	Gum found per 100 c. c. sample Milligrams
4	22	Copper dish	200	100	40	174
		Copper dish	200	100	40	131
		Porcelain dish	180	100	40	25
		Porcelain dish	180	100	40	23
		Silica crucible	35	20	40	25
		Silica crucible	35	20	40	27
		Glass dish	30	20	24	22
		Glass dish	30	20	24	20
		Glass dish	180	100	40	35
		Glass dish	180	100	40	40
		Glass beaker	300	100	40	62
		Glass beaker	300	100	40	41
3	2030	Glass dish	30	20	70	2003
		Glass dish	30	20	70	2060
		Glass dish	180	100	100	2387
		Glass dish	180	100	100	2278
2	5	Glass dish	30	20	24	5
		Glass dish	30	20	24	5
		Glass dish	180	100	24	5
		Glass dish	180	100	24	5
1	5	Glass dish	30	20	24	5
		Glass dish	180	100	24	5

* Baekeland, L. H., The synthesis, constitution, and uses of Bakelite. Jour. Ind. and Eng. Chem., vol. 1, 1909, pp. 149-161.
** Allen, A. H., Commercial Organic Analysis, vol 1, pp. 253-270.
*** Allen, A. H., Work cited, p. 259.

later, it was noted that aqueous extracts of cracked gasoline may deposit gums on evaporation. This was confirmed by extracting a sample of gasoline No. 4 with distilled water and evaporating the water to dryness on a steam bath; a deposit of gum resulted. Incidentally, it was found possible to reduce the gum-forming tendency of this gasoline by washing with water. A concentrated water extract of this same gasoline was then made and was treated with sodium bisulphite solution; a small quantity of crystals was obtained which appeared similar under the microscope to crystals characteristic of valeric aldehyde. When an aqueous extract of the gasoline was treated with phenol and a trace of sodium acetate, a resin having the properties of Bakelite, was produced.

All these facts point in the same direction—to the possibility of aldehydes being present in cracked gasoline, and to their responsibility for the formation of gum.

Origin of Aldehydes in Gasoline

The formation of aldehydes in gasoline can probably be studied most easily by recognizing the difference between untreated and acid-treated distillates. The usual treatment of crude gasoline with sulphuric acid may give rise to many chemical changes. Among others, it is probable that during the treating and subsequent washing, most of the aldehydes are removed. Thus gasoline Nos. 1 and 2, which contained little if any aldehyde, and which deposited merely a trace of gum, were known to have been previously acid and alkali treated, and washed. Gasoline Nos. 3 and 4, which contained large amounts of aldehydes and gave large yields of gum, were raw distillates. It is also known that acid treatment reduces the amount of unsaturation in a gasoline, and probably changes to some extent the character of the unsaturated bodies present. It has already been shown that there is no direct connection between the percentage of unsaturation and gum formation, but there may be an indirect connection. It has been demonstrated that oxidizing a gasoline increases the amount of gum that it will form; now, some unsaturated compounds may oxidize more easily than others, hence an acid-treated gasoline may contain less of these easily oxidized bodies than the raw distillate. A highly unsaturated gasoline can be oxidized more easily than a saturated sample, therefore, it seems probable that aldehydes are formed in gasoline largely by the oxidation of olefins or similar compounds.

A large amount of evidence in the literature confirms this theory. Brooks* quotes among others the work of Schoenbein on the oxidation of turpentine, of Fudakowski on the oxidation of light petroleum factions, of Engler and Weissberg and of Bach on the same subject. Rupture of the ethylene bond by autoxidation has been noted in many instances, aldehydes, ketones, and acids being formed; the methene group, $7C{=}H_2$, splits with the formation of formaldehyde or formic acid, as in the case of B-pinene. Kingzett has noted the corrosion of metal containers used for turpentine due to oxidation of the metal by formic acid. The effect of light in accelerating such oxidation has long been known. In the auto oxidation of styrene, marked polymerization occure, but in direct sunlight fission of the side chain occurs with the formation of formaldehyde and benzaldehyde. (See Stotte, Jour. Prakt. Chem. 1914, p. 151).

The effect of the sunlight in promoting auto oxidation has been studied by many workers, and it has been shown that under these conditions it is by no means limited to substances containing the ethylene bond, but very stable compounds, such as cyclohexane, are oxidized, and their carbocyclic structure ruptured.

Brooks† has published such a complete study of the literature on this subject that it seems unnecessary to go into further detail. It will merely be pointed out that the presence of aldehyde can easily be explained as due to the oxidation of compounds known to exist in cracked gasoline.

Storage Tests of Gasoline

One of the main objects of the present work was to determine the amount of gum that would form in gasoline when stored for a considerable time under diverse conditions. The experimental work already described indicated that samples of gasoline when stored in the presence of water and air were likely to deposit gums. Accordingly, identical samples of each of the four gasolines already described were placed in storage under different conditions.

It was planned to make the maximum storage time two years, and to make the examination periods 60 days each. This plan required that 12 samples of each set should be made up under exactly the same conditions, so that one could be removed and analyzed every 60 days. To study the effect of the air and moisture, respectively, it was necessary to store 12 samples with no air present; 12 with air; 12 with water and no air; and 12 with both air and water. Thus 48 samples of each of the four gasolines were placed in storage in glass bottles. Twelve additional samples of gasolines Nos. 2 and 4 were stored with both air and water present in iron cylinders.

Samples from each set have been examined after storage for 60 and 120 days, respectively. It is too early to predict the outcome of the whole series of tests, yet a few facts are of interest.

Results of Storage Tests

When these gasolines are stored in full bottles so that there is no air present, they do not change in gum-forming ability, although water may be present. Even highly unsaturated gasolines remain apparently unchanged. Moreover, when air is present with the sample, there is an increase in the amount of gum formed, particularly in the case of the cracked products, and when water as well, is present, the increase in gum is much more pronounced. Light also seems to act as a catalyst, but its action is apparently not as great as that of water.

The results of the storage of gasoline in iron containers in the presence of air and water is also interesting, as the increase in gum is much less than when the same gasolines are stored with air and water in glass bottles. This result may be due to the catalytic effect of light, or it may be true that in the presence of iron the oxidation progresses beyond the aldehyde stage. Though the iron containers did not show a large increase in gum formation, there was a very marked corrosive effect on the container. Considerable iron rust was found in all samples stored in iron, and it had to be removed before the gum could be determined. The iron containers were sawed in half, and it was noted that there was practically no corrosion above the water level. The bottom of the container, in each case, was corroded. This corrosion may be due to the formation of organic acids instead of aldehydes, when the gasolines are oxidized in the presence of iron.

These storage tests will be continued for two years, and possibly other tests will be made along similar lines that may prove of interest, and the results will be reported as soon as they are completed.

Summary and Conclusions

A study of various methods of evaporation and oxidation of cracked gasolines leads to the conclusion that gummy and resinous deposits are caused by oxidation, and have no direct relation to unsaturation as determined by solubility in sulphuric acid. In the present investigation a new and convenient method was developed for determining "gum" in gasoline. The study of gums and their formation described in the foregoing pages leads to the conclusion that they are polymerized aldehydes, which probably are formed by the oxidation of olefins, etc. The storage tests included in this paper confirm the above conclusions.—Reports of Investigations, U. S. Bureau of Mines.

*Brooks, B. T., The Chemistry of the Non-Bensenoid Hydrocarbons, 1922.

†Work cited.

What Is Pressure in Tank Cars of Natural Gasoline?

Bartlesville, Okla., Aug. 15.—D. B. Dow, assistant organic chemist, Bureau of Mines, has conducted a series of experiments at the Bartlesville station to determine the pressure and temperatures developed in tank cars loaded with natural gasoline, and contrary to expectations, it was found that the pressure developed in tank cars in transit was considerably less than when the cars were standing still.

This is probably due to the fact that the gasoline was constantly agitated, and it was not possible for the surface of the gasoline to reach a high temperature as was the case when the cars were standing.

St. Louis, Mo.—The Indiahoma Refining Company has opened a Chicago office at 14 East Jackson boulevard with C. H. Warner in charge. General offices of the Company are located in St. Louis.

Oklahoma City, Okla.—It has been announced here that the Francis Oil and Refining Company has contracted for 18 tank cars to handle the output of their refinery at Francis in this state.

J. E. Fisher, once superintendent of the Oklahoma Refining plant, will serve a similar capacity in the plant just taken over by Turley.

Corrugated Asbestos Board As Tank Covering

May decrease evaporation loss—Marland Refining Company now making experiment

PONCA CITY, OKLA.—Experiments with corrugated asbestos board as coverage for crude storage tanks to decrease the evaporation of high gravity oils and refined products are now being made by the Marland Refining Company of this place. The Bureau of Mines, working in conjunction with the company, has placed thermometers at advantageous points within the tanks and coverings and will make a report on the figures obtained in the near future.

At the company's refinery three tanks of the 64,000 barrel type have been covered with the asbestos board and steel frameworks for two more coverings have been put in place. Work of erecting the first framework about the tanks started in 1920 but the asbestos jacket was not completed until early 1921 due to bad labor conditions.

Preliminary tests on vapors above the oil in the tankage have been accomplished by the engineering department of the Marland Refining Company co-operating with the refining branch. Vapors in the covered tanks are found to be several degrees cooler than vapors in uninsulated tanks. Tests started in July by the Bureau of Mines will continue 60 days and will give accurate temperature tests by specially checked thermometers on both the oil and the vapors of the insulated tanks.

Credit for the idea of using corrugated asbestos as an insulation medium is given the California oil operators, according to Van T. Moon, chief engineer for the Marland Refining Company. The type of covering used in this case is a product of the Marland engineering forces and is patented by this concern. Design for the steel framework, surrounding the tank and supporting the asbestos sheets, is the result of the Marland forces, co-operating with the Wisconsin Bridge and Iron Works engineers. The latter concern fabricated and erected the steel.

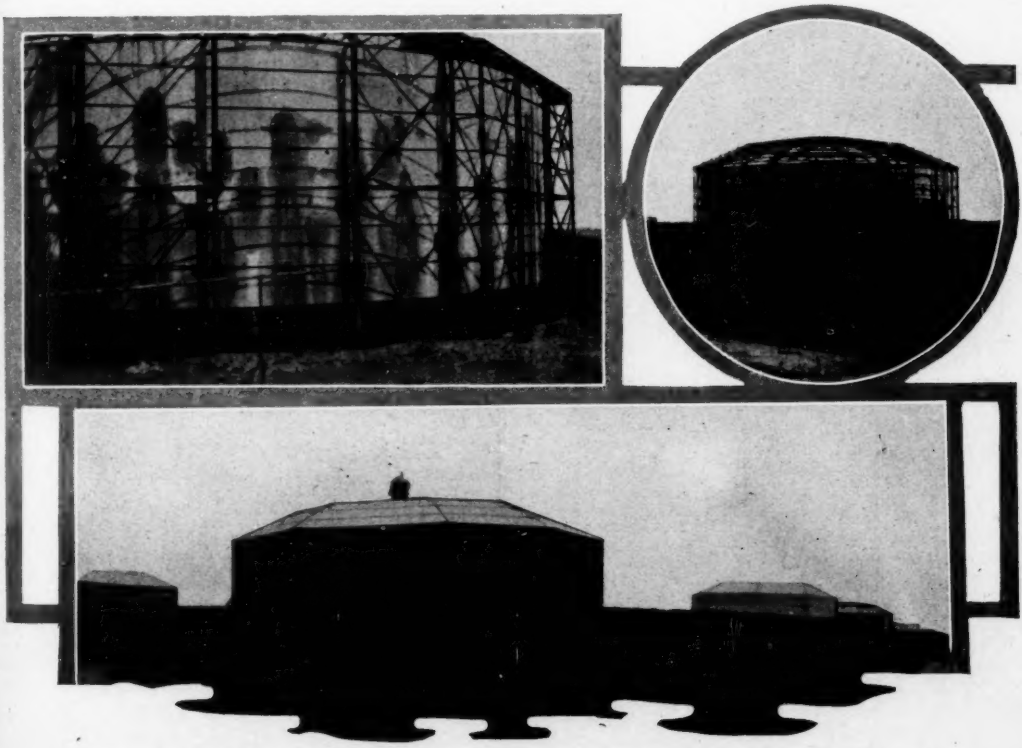
The design of the framework does not allow the steel frame to touch the tank, thus insulating the tank and affording additional protection from lightning. The frame is built around eight main columns, which support the remainder of the steel work.

The columns are set in concrete foundations and support eight main trusses fastened together at the converging point by means of a circular girder, 36 inches in diameter. The total span of the trusses is 120 feet. The columns are 35 feet high. Intermediate truss beams and purlins are planned to carry the sheeting. Depth of the arch truss is 2 feet 9 inches. Foundation for the columns extends one foot above the base of the tank.

The main supporting columns of the steel framework are made of four angles measuring 3½x5x⅜ inches, latticed. The trusses are composed of four angles. Two angles in the upper part measure 3½x6x⅜ inches and the two lower angles measure 3½x5x5/16 inches.

The self-supporting feature of the framework, due to the columns and crossed trusses is a Marland development, as the early California insulations carried the insulating material over a framework resting on the tank itself. Distance from the framework to the shell of the tank varies from 4½ feet at the sides to 8 feet at the top.

Completed insulation gives an octagonal roof of two different pitches, surmounted by a large ventilator. Side insulation is vertical and is put on in eight large sec-



Upper right—Close view of framework for asbestos covered tank. Upper left—Steel framework complete. Lower—Group of asbestos covered tanks on Marland farm

tions. Space of one foot is left from the bottom of the insulation on the shell to the ground. This space admits air which flows continuously up and around the tank and out of the ventilator at the top. Adequate circulation of air is accomplished by making the ventilator of sufficient size, 72 inches in diameter, thus giving a chimney effect to the inside of the shell. Ventilator revolves in the slightest breeze.

The sheeting material itself is corrugated asbestos, such as is commonly used in roofing. It is 3/16 inch thick and while the sheets vary in length, they are uniformly 27½ inches wide. The insulation is laid with a 6-inch lap set in slater's cement at the joints on the roof, and a 4-inch lap on the sides.

Some indication of the size of the engineering problem is gained by the fact that the jacket area within the asbestos sheeting is about 30,000 square feet. The tanks to be protected measure 114 feet 7¾ inches in diameter by 34 feet 10¼ inches high.

Two main features of interest were worked out by the Marland engineers. The first has been mentioned. It is the self-supporting steel framework, insulated from the tank. The second was the covering of a round tank with an octagolan building, using corrugated sheets.

By means of the protection from the sun's rays afforded by the insulation and the current of air about the tank created by the design of the shell, Marland engineers hope to get away from the "breathe" of the storage tanks during the hot days of the summer.

The Marland Refining Company is also experimenting with revolving water sprays placed on the top of storage tanks to cause further cooling. The sprays revolve under water pressure and consume about 15 gallons a minute. They use one orifice which throws the water out about 45 degrees off horizontal. Tests by the Bureau of Mines will include figures on the tanks cooled by the sprays alone, tanks cooled by the sprays and insulation and tanks cooled by insulation. Data when compiled is expected to be of tremendous interest and advantage to refiners and companies compelled to store large quantities of high gravity oil.

Statistical Department for Western Pet. Refiners

Kansas City, Mo.—The Western Petroleum Refiners Association has established a statistical department under the direction of Harry K. Davis, who has had considerable experience in the statistical end of the oil business. It is proposed to keep members of the association informed on all matters relating to the manufacture and sale of petroleum products, particularly with reference to stocks and activity of Mid-Continent refiners, according to John D. Reynolds, secretary, who made the announcement.

Tulsa, Okla.—Reports from Oklahoma City that the Empire Refineries plant there would resume operations shortly are denied by company officials in Tulsa. The Oklahoma City plant has a rated capacity of 2000 barrels.

Gasoline Stocks at United States Refineries Show Decrease in July

WASHINGTON, D. C. — Gasoline stocks at refineries in the United States July 1 registered a slight decrease from the figures for the previous month, according to statistics compiled by the Bureau of Mines, which show 824,966,456 gallons on hand. This is a decline of approximately 32,000,000 gallons from figures for June 1, reflecting the normal seasonal drop due to increased use of automobiles in the summer months.

Domestic consumption of gasoline for June was 507,000,000 gallons as compared with 499,000,000 gallons for May and 386,000,000 gallons for April. The May figure represents an increase of 41 per cent in consumption as compared with May a year ago, while a similar comparison for June shows a 14 per cent increase, a more nearly normal figure. Stocks for June are 10 per cent in excess of June a year ago.

Production of gasoline for June amounted to 525,940,600 gallons, an increase of 12,000,000 gallons over May and 51,000,000 gallons over April.

Figures furnished the Bureau of Mines by refiners for the first six months of 1922 show an increase of 9.9 per cent in domestic production of gasoline as compared with a similar period in 1921. The increase in domestic consumption is 6.1 per cent in excess of this amount or 16 per cent.

A daily average of 1,547,000 barrels of oil was run through the stills of the 310 refineries reported as operative during the month of June. These figures show a daily increase of 30,000 barrels in the amount of oils run and a decrease of five in the number of operating plants reporting as compared with the month of May. Plants reported during June were running an average of 88 per cent of their daily indicated capacity. In addition to the plants referred to above, it is estimated that there were probably ten plants of small total aggregate capacity, operating during June from whom no advices of any nature were received by the Bureau of Mines.

Imports of gasoline for June amounted to 3,986,655 gallons; exports were 52,730,889 gallons, and shipments to insular possessions were 1,872,776 gallons.

Production of kerosene for June amounted to 173,649,592 gallons, a daily average increase of 181,000 gallons. Stocks of kerosene on hand July 1 amounted to 317,574,464 gallons, a decrease of 1,300,000 gallons for the month. Exports and shipments of this product were 71,500,000 gallons.

Production of gas and fuel oils in June amounted to 903,056,578 gallons, which is a practical maintenance of the May rate of production. Stocks on hand July 1 were 1,326,662 gallons, which is a slight increase.

The output of lubricating oil for June was 80,138,257 gallons, which indicates a daily average increased production of 95,000 gallons. The seasonal demand for lubricants reduced stocks to a figure of 226,903,812 gallons on hand July 1, a decrease during the month of 39,000,000 gallons.

Western Petroleum Refiners Urge Working Out of Jobber Contracts

KANSAS CITY, MO.—For the first time in the history of the organization the Western Petroleum Refiners Association is recommending to all its members the working out of fair and equitable marginal contracts to be entered into with independent jobbers to the extent of approximately 30 per cent of each refiner's output. Also that the refiner put up a bond guaranteeing steady and regular delivery regardless of price fluctuations and that a similar bond be put up by the jobber for steady and regular acceptance of shipments of refined oils regardless of price changes.

This is the sum total of results accomplished at the joint conference of refiners and jobbers held in Kansas City August 14 and 15 to work out a basis for marginal contracts. The refiners' committee at the conference was composed of D. W. Moffitt of Tulsa, vice president Cosden and Company, chairman; L. L. Marcell of Kansas City, president of the White Eagle Oil and Refining Company; F. A. Pielsticker of El Dorado, Kansas, vice president of the Midland Refining Company. The jobbers' committee was made up of Fred C. Cramer of Denver, preident of Denver Powerine Company, chairman; L. W. Freeman of the Lake Park Oil Company of Sioux Falls, South Dakota; W. L. Zust of the Interstate Oil Company of La Crosse, Wisconsin. L. V. Nicholas of Chicago, president of the National Petroleum Marketers Association, also was present.

After separate deliberations by refiners and jobbers a joint session was held and a round-table discussion ensued. The Douglas plan of marginal contracts was not adopted. D. W. Moffitt acted as chairman at the joint meeting and L. V. Nicholas as secretary.

BUREAU TO MAKE SURVEY OF FOREIGN CRUDE OILS

Washington, D. C., Sept. 28.—A survey of foreign crude oils will be made by the Bureau of Mines upon the completion of the survey of crude oils in the United States now in progress. In the survey of crude petroleums in the United States, reports containing data on the properties of crude oils from Eastern fields; the Rocky Mountain fields; Northern Louisiana, Northern Texas, and Arkansas, Kansas and Oklahoma have been published. Samples of crude oils collected throughout the Gulf Coast fields are now being examined.

How About Stratification of Blended Product?

Some observations on practices and results on mixing of natural gasoline and heavier stocks

Because the larger companies in California make a practice of turning their natural gas condensate back into the crude oil, and thus produce only the straight still-run gasoline for commercial purposes, the idea has developed in some quarters that blended gasoline does not maintain a uniform series of fractions in distillation.

And, going one step further, it is argued that under certain conditions, a blended gasoline will stratify, the lighter fractions, the natural gas condensate, rising to the top, and the heavier fractions going to the bottom of the container.

The fallacy of both these ideas is abundantly proven by exhaustive tests upon products that have been properly blended, and where the naphtha used for toning down the gas condensate is such as to make a mixture with a uniform series of fractions between the temperatures at which distillation begins and finishes.

The practice of turning the natural gas condensate back into the crude oil has its economy in more than one way. Where natural gasoline plants are located near crude oil storage, the high gravity condensate from these plants may be turned into the crude with only a matter of a very few minutes elapsing between the time it is condensed and the time it is immersed in the crude. In fact it may never be exposed to the air at all, in such practice. The economy of this program is readily recognized. A condensate of 78 to 82 Be. takes a heavy loss by evaporation, in spite of every precaution against it, in going to storage, and being rehandled in the blending process.

Thus the loss from evaporation is practically eliminated, by turning the condensate into the crude oil, and since all fractions of petroleum oils are soluble, one in the other, these light fractions of the natural gas condensate are held down by the heavy crude into which they are dissolved, until such time as the crude can be refined. And since they remain in solution in the crude oil, there is no loss in volume due to the process, for the ultimate recovery of commercial gasoline is equal to the amount of such fractions originally contained in the crude oil, plus the natural gas condensate injected therein.

Another consideration which probably tends to stimulate this practice is the fact that the larger companies have developed their trade to the use of a straight run, uniform motor fuel, known by a highly advertised trade name, and varying little in gravity from season to season and from year to year. A blended product, though equal in quality to the straight run gasoline, would have to be marketed as a blended product, and this would only add confusion in marketing and handlilng the gasolines.

In order that there may be a minimum of carbon deposits in motor cylinders, and complete combustion, it is necessary that the distillate used in blending make a uniform series of fractions in the blended mixture, with none of the fractions with boiling points so high as to cause incomplete combustion. Blending is not simply a rule of thumb method of mixing high gravity natural gasoline, raw, with a distillate cut below the gasoline run. Unless the naphtha used in blending is so related to the raw condensate that the initial point and end point, and all intermediate fractions in distillation, clearly establish the uniformity of the mixture, it is not a high class motor fuel. The lack of uniformity in the distillation series will tend to an uneven or incomplete combustion, and the consequent lack of power, and carbon troubles, within the cylinders.

With the proper care being taken in the selection of the products to be used in the blending, however, and with this work in the hands of men who know what they are doing, there seems to be no scientific reason why a blended motor fuel may not be of equal power and equal value to any straight still-run product.

That the act of blending may be done in a haphazard way, and an inferior product be the result, is shown by the following discussion by Rittman, Dean and Jacobs, based upon a study of blended gasolines seven years ago.*

"They state that the blended casing head products have larger percentages distilling below 50 C, but have longer distillation ranges, which tend to make the slope of the temperature-percentage curves for these gasolines flatter than those of straight refinery products. They also state that any gasoline having an unusually large distillation cut below 50 C, and with considerable percentages distilling within the temperature ranges of 150 to 175 C, and 175 to 200 C, and being deficient in constituents boiling at intermediate points of the distillation, may be classed as one of these blended products."

A marked difference is shown in the gravity of the naphtha used for blending in California and in the East, though the end points are approximately the same. The blends formed also have different gravities, East and West, though here again the end points, power developed per gallon, and the completeness of combustion, are practically the same.

Regarding Stratification

The following discussion of the stratification of blended gasoline† tends to set at ease the minds of those who have hesitated in offering this material to the public, with the idea that it does not "stay put."

"In many quarters belief has been expressed that in blended gasoline the light condensate fractions separate from the heavier distillate fractions, causing stratification. It is true that owing to changes of temperature, in a closed tank, the lighter fractions at times vaporize and condense on the sides of the container and drain down, floating in a thin layer on the top of the liquid. This condition may have given rise to the belief regarding stratification, but, as shown, is not due to separation of the two or more blended constituents through differences in their gravities. All fractions of petroleum oils are generally considered soluble, one in the other, and a blend of two or more fractions such as naphtha and condensate should not separate or stratify. All evidence obtainable indicates that no such stratification actually takes place in blended motor fuels through the difference in specific gravity of the members blended. A test made on California blended product showed no separation. The blend, which was a small quantity of condensate with a gravity of 150 Be. and a large quantity of distillate with a gravity of 48 Be., was placed in a ten barrel tank and tested after standing one week without being disturbed. Samples drawn from the top and bottom had specific gravities differing only 0.07 Be."

*Technical paper 163, Bureau of Mines, 1916. †Gasoline and Other Motor Fuels, Ellis and Meigs, page 490.

Freight Rates Reduced From Oklahoma Points

Washington, D. C.—Rates on petroleum and its products from Devol, Frederick and Altus, Oklahoma, to Kansas City, Chicago, St. Louis and Omaha were held unreasonable and unduly prejudicial to the extent that they exceeded rates from the Burkburnett group in Texas in a decision which has been handed down by the Interstate Commerce Commission in the case of the Constantin Refining Company against the Ahnapee and Western railroad and others.

The commission also held tnat the rates from Frederick, Devol and Altus to point in Texas were unreasonable to the extent that they exceeded for like distances rates contemporaneously in effect from Shreveport, La., to Texas destinations.

Railroads have been given 90 days in which to establish new rates in conformity with the findings of the commission.

Low Recovery in Carbon Black Manufacture

Washington, D. C.—The relatively low efficiency, 2.5 percentage of recovery of present methods of producing carbon black, is due to the waste of the resulting heat, states the Bureau of Mines in a recently issued bulletin. In some districts, however, as in the Kanawha Valley of West Virginia, it might be feasible to utilize this heat in the evaporation of brines that yield sodium chloride and bromine. One company is doing some experimental work on dehydrating fruits and vegetables by the waste heat; such heat might be transformed into electrical energy for areas within carrying distance of the plants, or might be used to electrify short railways.

XUM

The Manufacture of Lubricating Oils

Brief outline of methods used in manufacturing lube oils and stocks

By F. N. Williams

The general purpose of lubricants is to prevent direct contact of the various moving parts of machinery, bearings, etc., which contact generates friction to a greater or lesser extent, and when the moving parts are properly lubricated, the metallic friction is largely eliminated and replaced by the negligible internal friction of the lubricant.

The proper selection of a lubricant for any specified purpose is of more than ordinary importance as the lubricant must possess enough viscosity to prevent the moving surfaces to which it is applied from coming in contact with each other under the maximum pressure which may be applied to them, and to prevent itself from being squeezed out, or the property of adhesion to such an extent that it will penetrate by capillarity where the danger of wear and contact is the greatest and cohesion enough to prevent the particles being forced apart by pressure.

As adhesion increases directly with viscosity, it is obvious that an oil should be selected with a viscosity in relation to the bearing pressure upon which it is to be applied, this however, must be carefully considered as speed is an important factor, that is, a bearing revolving at high speed but low pressure will require an oil of low viscosity, the other extreme being high speed and pressure which requires a very viscous oil.

Considerable power waste is experienced in using a heavy viscous oil for high speed, low pressure bearings due to the high internal friction of such an oil. Hydrocarbon oil possesses the properties required of a first class lubricating oil, i. e., the capacity for storing and carrying away heat. Little tendency to oxidize by exposure to air. Freedom from acidity and consequent corrosion. High decomposition temperature. Low temperature of solidification Minimum evaporation at working or service temperatures. Lubrication may be divided into the following:

General lubrication of shaft machines (external), steam engines (external), bearings, etc., under ordinary atmospheric conditions.

High temperature lubrication in contact with steam of steam cylinders and valves.

High temperature lubrication of internal explosion engines.

Oils for general lubricating purposes as mentioned above should, if satisfactory physically, be further examined to determine their resistance to the common destructive agents, oxygen and water, and while oxygen has little action on hydrocarbon oils, water plays an important part in rendering turbine oil unfit for use and should the oil to be used for turbines fail to pass the emulsification test satisfactorily, it should be rejected. Heat does not as a rule occupy a very important role in this class of oils and although the danger of ignition is present, should the oil become unduly heated, this danger is almost non-existent, the oils being of a sufficiently high flash point to retain volatile vapors at any reasonable temperature consistent with the designed purpose of the oil.

The lubrication of steam engine cylinders is a subject of great importance as the oils are subjected to three main conditions: pressure, heat and moisture.

The effect of high temperature upon oils is to cause them to lose viscosity, which loss of viscosity decreases the adhesiveness of the oil for the hot surfaces. Steam refined and filtered cylinder oils lose less viscosity upon heating than fat oils, which accounts for the demand in European markets for high test cylinder oil, where the use of superheated steam at high pressures is very common.

Cylinder oils are very often compounded with varying quantities of lard oil, acidless tallow, degras, etc., for different purposes. The use of too large quantities of fatty oils may be injurious in that they are decomposed under heat and steam into fatty acids and glycerine. The glycerine being volatile passes out with the exhaust steam, leaving the fatty acids to corrode the metal. Corrosion is followed by pitting and consequent increased friction.

Steam cylinder oils should not contain any soapy components, as these cause the steam to form emulsions with the oil, which would be carried away with the condenser water instead of lubricating. This class of oils should also be practically free from tar.

The oil used for the lubrication of internal combustion engines must be of the best quality by reason of the severe strain and shock and the great heat of the exploded gases, to form an effective cushion between the rubbing surfaces. Those oils should be carefully examined to determine their quality, as the mere knowledge of their gravity or viscosity is a very poor guide, it being easy to mix the light and heavy portions of an overhead distillation of lubricating fractions to almost any desired gravity or viscosity while the middle cut between the mixture is all that could be desired it is the reverse with the mixture.

Compounded oils of the highest quality of American oils mixed with highly refined fatty oils are being used on the continent for this class of lubrication.

Recovery of Lube Oils

Oils used to lubricate machinery and even gasoline engines are often collected and used again, the oils after use being darkened and containing mechanical impurities and water.

The mechanical impurities and water may be separated by means of a centrifuge of the Sharples or DeLaval type. The recovered oil being available for re-use at once. With compounded cylinder oils it is necessary to look for an increase in free acid asphaltic substances and iron soap.

Carbon Residues

Considerable residual matter is found in steam and gas engine cylinders and in air compressors. The character of such matter being of a pitch like carbonaceous nature. That these bodies are formed is traced to the oxidation of the oils and consist of lubricating oils, partly unchanged and partly changed to asphaltic and corbonized bodies with small quantities of the metals involved.

In selecting cylinder oils particular attention should be paid to the tar test, and an oil may be rejected if an undue amount of tar is present even though the flash, fire, viscosity and cold test are satisfactory. Tar is more likely to be present in high test stocks than in light or medium stocks.

Comparative Tar Tests of Various Cylinder Oils

Tar Test determined by H_2SO_4 follows:

Oils mixed with an equal volume of 55.0 gravity straight naphtha, which in itself contained 1 per cent of tar.

Trials of different acids and methods 100 cc. of mixture used.

Grade	Amt. of Acid	Acid	Duration of Agitation	% of Tar by Vol.
600 S. R.	30 cc.	C. P.	20 mms.	15.0
600 S. R.	30 cc.	com'cl	20 mms.	7.0
600 S. R.	30 cc.	Restored	20 mms.	12.0
600 S. R.	45 cc.	C. P.	20 mms.	17.0

Comparative Tests on Ranger Crude Before Treating and Treated Stock

Gravity (Flash Fire)	39.7 Below 70° F.	37.2 Below 70° F.
Vis. @ 70 Saybolt	44	47
Vis. @ 100 Saybolt	37	40
Pour	0	0
Color	900 Lovibond	288 Lovibond
Sulphur	.136	.132
Tar	8%	4%
B. S.	Trace	Nil
Dist. 100 cc. I. B. P.	150° F.	182° F.
Percent over @ 212	4	2
Percent over @ 302	19.0	9
Percent over @ 350	26.5	17.5
Percent over @ 365	29.0	20.0
Percent over @ 375	30.0	21.5
Percent over @ 400	33.0	24.5
Percent over @ 460	40.5	34.0
Percent over @ 500	46.5	41.0
Grav. on Overhead	51.9	48.6
Treating loss	....	6%

20 lb. S. 66° Acid used in two dumps on treating crude.

600 S.R. 10 cc. C. P. 20 mms. 7.0
600 S. R. Filt. Penn. 30 cc. C. P. 10 mms. 14.0
G. Cyl. 30 cc. C. P. 20 mms. 13.0

Cylinder Oil

94% 600 S. R., 5% Ex. W. S. Lard, 1% Fish Oil
30 cc. C. P. 20 mms. 21.0

Cylinder Oil

90% 600 S. R., 5% 200 Vis. Red Oil, 3% Acidless Tallow, 2% Degras
30 cc. C. P. 20 mms. 19.0

Cylinder Oil

88% 600 S. R., 11% Ex. W. S. Lard Oil, 1% Fish Oil
30 cc. C. P. 20 mms 30.0
650 S. R. 30 cc. C. P. 20 mms. 20.

Cylinder Oil

70% S. R., 30% 200 Vis. Red
30 cc. C. P. 20 mms. 13.0

The above tar tests are merely comparative and are not true tar values. The high percentages noticed in the compounded oil are due to the presence of fatty oils which are precipitated by the action of the acid.

It is sometimes customary to determine the tarry matter by mixing 5 cc. of the cylinder stock with 95 cc. of 86° Be. gasoline in a graduated oil tube allowing the mixture to stand and observing the quantity of precipital. This test is also not a true tar test but indicates the free tarry and carbonaceous matter existing in the oil at ordinary temperatures, which matter was formed during the manufacture of the stock.

General Manufacture of Cylinder Stocks

Steam Refined Cylinder Stock may be described as the residue of suitable crudes remaining in the still after all the lighter products are distilled off.

Stocks may be made from many crudes namely in the United States from Pennsylvania, Muskogee, Oklahoma, Ranger, Texas, West Virginia, etc., straight, and from many Mid-Continent and other crudes after acid treatment.

To obtain a cylinder stock of light color and very low tar content, some of the first mentioned crudes are treated, the best practice is to first reduce the crude to remove the valuable gasoline products which would otherwise be lost by evaporation upon chemical treatment. This loss may be noted in the following table which shows Ranger crude before and after treatment wiht 20 pounds per barrel of 66 acid using the acid in two dumps.

The crude in treatment suffered a loss of 6 per cent by volume, all of the loss with the exception of the tarry matter recovered being in the valuable light end.

The stills in which cylinder oil is made are equipped with perforated steam pipes inside and at the bottom, the perforations should be at least ¼-inch or the spray pipes may have instead of perforations openings 1/82 or more wide and extending at intervals the full length of the pipes.

As the purpose of the steam is to carry the vapors away as they are evolved, to prevent re-heating and cracking, it is essential that the stills be equipped with sufficient vapor outlet to permit free exit of the out-going vapors so large and numerous vapor lines should be provided.

It is well to maintain even heat beneath cylinder oil stills, gas in conjunction with oil being the best fuel as it enables the operator to hold the proper temperature with evenly distributed heat and eliminates the possibility of super-heating any certain section of the still bottom, which in turn would produce a certain amount of cracking, thereby producing tarry matter, low flash, poor color and loss of viscosity.

One of the most important features of reducing crudes, etc., to cylinder stock is the removal of the paraffin, which may be accomplished by manipulating the steam at the proper time and temperature.

The reductions for cylinder oils should be first made experimentally and the temperatures at which most of the paraffin distills overhead determined, then at the predetermined temperature the still should be given all the steam possible and that temperature maintained.

The writer has had occasion to closely note many runs from cylinder stock from Ranger crude, and it was clearly indicated that when the temperature was as rapidly as practicable brought to the critical temperature, and maintained at that point while steaming heavily, the pour test which normally ran 30 to 40° F., was reduced to 15° F.

Time is also a factor, as for example, if a crude reduced for cylinder stock is reduced too fast, the required viscosity will be reached before the proper amount of paraffin is removed, the result being that most of the paraffin remains in the base, rendering the cold test too high, the yield will also be somewhat reduced due to the "throwing over" mechanically of some of the heavier constituents.

Yield of Cylinder Stock from Ranger Treated Crudes

% of Crude	Grav.	Flash	Fire	Vis. @ 212°F.	Pour
18.4	21.9	490	565	144	25
18.4	21.9	490	565	144	25
16.7	21.4	500	570	151	30
15.5	21.4	500	585	167	35
14.4	21.3	520	595	189	30
13.6	21.4	535	615	190	45
12.0	21.0	540	620	206	45
10.0	20.4	545	630	213	30

The following table is a complete run of Ranger crude to cylinder stock giving the tests of the base at various intervals during the run, the temperature hourly, and the gravity Baume of the heavy worm hourly.

Treated Ranger Crude
Grav. 34.4

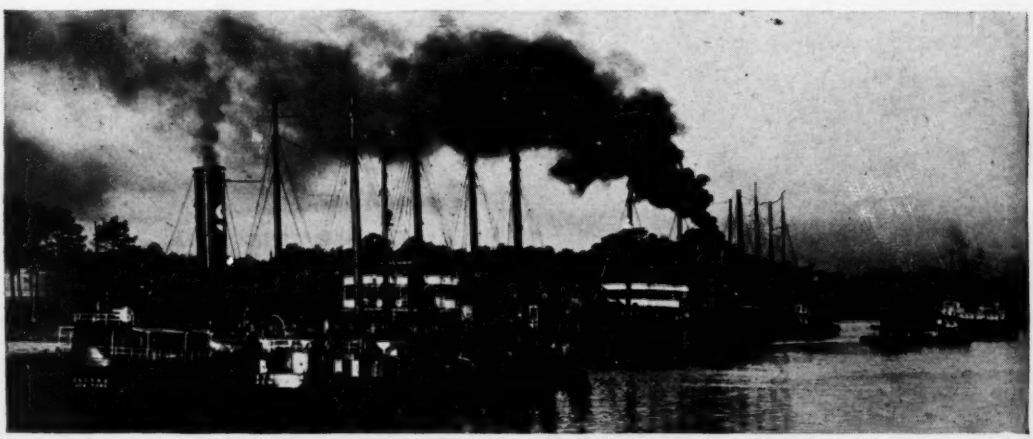
L. W. H. W.
Start to 48.0 Naphtha Start to 48.0 Naphtha
48.0 to color Kerosene 48.0 to color K'sene
Color to Vis. Gas Oil Col. 205 Vis. Gas Oil

Muskogee crude also produced first class cylinder stock but the production has diminished to such an extent that it is only being used in a few plants in Oklahoma.

Average Tests of Muskogee Crude

Gravity, 38.0
Flash, below 60° F.
Fire, below 60° F.
Viscosity, 38@100° F.
Pour, 0° F.
Color, Green.

Table of run of Muskogee crude to cylinder stock in a 1250-barrel still, giving



Magnolia Petroleum Company's wharf at Beaumont, Texas, on the Neches river. The Magnolia Petroleum Company's Beaumont refinery is one of the largest on the Gulf Coast and operates largely on North and West Texas and Mid-Continent crudes brought from the interior by pipe lines. The Magnolia moves considerable light stuff to the Atlantic seaboard and for export over this wharf.

The plant is now adding 20 new pressure stills of the Burton type, making 120 Burton stills at the refinery.

Time	Heavy Worm	Temp.	Front	Back	Samples taken From Still
7 P. M.		305			
8	55.5	340	½ sp.	½ sp.	No. 1 Sample
9	51.3	360	1 sp.	1 sp.	10 P. M.
10	47.8	385			Grav. 23.9
11	46.8	400			Flash 470
12	46.2	415			Pump Sample Vis. 112 @ 212° F.
					Grav. 20.4 Fire 540
					Flash 545 Pour 40
					Fire 630
					Vis. 213
					Pour 30° F.
1 A.M.	45.4	425			
2	44.8	440			No. 2 Sample
3	44.0	455			Grav. 23.9
4	43.0	475			Flash 475
5	42.0	490			Fire 540
6	40.6	515			Vis. 110 @ 212° F.
7	39.5	530			Pour 35
8	38.6	545			11 P. M.
9	37.5	565			No. 3 Sample
10	36.6	580	2 sp.	2 sp.	12:00 M. N.
11	35.5	595			Grav. 23.1
12	34.9	610	3sp.	3 sp.	Flash 480
1 P.M.	33.9	685			Fire 540
2	33.5	640	4 sp.	4 sp.	Vis. 130 @ 212° F.
3	32.7	650			Pour 35
4	32.4	670			
5	31.7	670	5 sp.		No. 4 Smple
6	31.3	670			1 A. M.
7	31.0	665			Grav. 23.1
8	30.7	665	5 sp.	5 sp.	Flash 495
9	29.8	665	1½ sp	5½ sp	Fire 555
10	28.4	665			Vis. 134 @ 212° F.
11	28.0	665			Pour 35
12	27.8	665			
1 A. M.	27.6	665			No. 5 Sample
2	27.4	668	1 R	1 R	2 A. M.
			No. 8	No. 9	No. 10
3	27.0	670	Sample	Sample	Sample Grav. 22.7
4	26.7	670	5 A. M.	6 A. M.	7 A. M. Flash 500
5	26.3	670	Grav. 21.5	21.9	21.9 Fire 575
6	26.3	670	Flash 535	535	540 Vis. 140 @ 212°F
7	26.0	670	Fire 620	620	625 Pour 30
			Vis. 194	192	202
			Pour 25	25	25 No. 6 Sample
					3 A. M.
					Grav. 221.
					Flash 500
					Fire 580
					Vis. 165 @ 212° F.
					Pour 30
					No. 7 Sample
					4 A. M.
					Grav. 21.3
					Flash 515
					Fire 590
					Vis. 165 @ 212° F.
					Pour 30

sp-Spokes open on steam valve.

physical tests and temperatures as the run progressed:

Flash	Fire	Grav.	Vis. @212° F.	Pour °F.	Temp. °F.
470	545	23.4	142	75	645
480	550	23.2	155	65	645
495	565	22.8	165	45	650
505	575	22.6	176	40	655
510	585	22.4	185	40	660
520	595	22.0	209	40	660
540	615	21.9	215	40	665
545	615	21.6	237	40	665
545	615	21.5	241	40	670
545	615	21.2	255	40	670
560	640	21.1	267	40	680
560	640	21.0	272	40	685
560	640	21.0	279	35	690
565	650	20.9	285	30	695

Yields and Tests of Muskogee Cylinder Stock

Yields % of Crude	Grav.	Flash	Fire	Vis. @ 212	Pour °F.
40.0	26.0	430	490	103	65
25.0	23.1	485	565	158	50
22.5	23.0	485	565	169	55
22.0	22.9	505	575	178	40
18.5	22.3	510	590	224	45

Pennsylvania crude reduced for cylinder stock of various viscosities:

The Crude

Gravity, 44.0 Be.
Flash and fire @ 60° F. or below.
Viscosity, 37@100° F. Saybolt.
Sulphur, .079.
Pour, 0° F.

The "Cuts" are as follows:

Over to 53.0 Be. . . . . Naphtha
53.0 to 41.5 . . . . . Kerosene
41.5 to 40.0 . . . . . Mineral Colza
40.0 to 34.0 . . . . . 37.0 Dist.
34.0 to off . . . . . 34.0 Dist.

and a special cut for Gun Oil if wanted 51.0 to 47.5.

Cylinder Stock Bases

No. 1. Gravity, 28.2 Be. Viscosity, 104@212. 17.5% of crude. Time required to run, 26 hours.

No. 2. Gravity, 27.5 Be. Viscosity, 130@212. 15.0% of crude. Time required to run, 28 hours.

No. 3. Gravity, 26.5 Be. 13.0% of crude. Viscosity, 165@212° F. Time, 30.5 hours.

"N" Cylinder. Gravity, 25.5 Be. Viscosity, 175@212° F. 11.0% of crude. Time, 31.5 hours.

Loco. Cylinder. Gravity, 24.5. Viscosity, 205/20@212° F. 9.0% of crude. Time, 33 hours.

Ex. L. L. Cylinder. Gravity, 22.0 to 22.5. Viscosity, 345@212° F. 6.0% of crude. Time, 37 hours.

Pennsylvania cylinder stocks of over 610° F. Fire test are not filtered.

Various uses and tests of Pennsylvania Cylinder stocks.

No. 1

Gravity, 24.0
Flash, 620° F.
Fire, 720° F.
Viscosity, 260@212° F.
Cold Test, 30.
Color, Green.
Suitable for marine, locomotive cylinder lubrication, gear cases, transmissions, worm gears, etc.

No. 2

Gravity, 25.0.
Flash, 600.
Fire, 690.
Viscosity, 235@212° F.
Cold Test, 30.
Color, Green.
Steam pump cylinders and other heavy work of this nature, tempering oil, etc.

No. 3

Gravity, 24.0.
Flash, 500.
Fire, 575.
Viscosity, 150@212° F.
Cold Test, 45.
Color, Light Green.
General purpose cylinder oil.

No. 4

Gravity, 24.0.
Flash, 500.
Fire, 575.
Viscosity, 145@212° F.
Cold Test, 45.
Color, Transparent.
General purpose cylinder oil.

No. 5

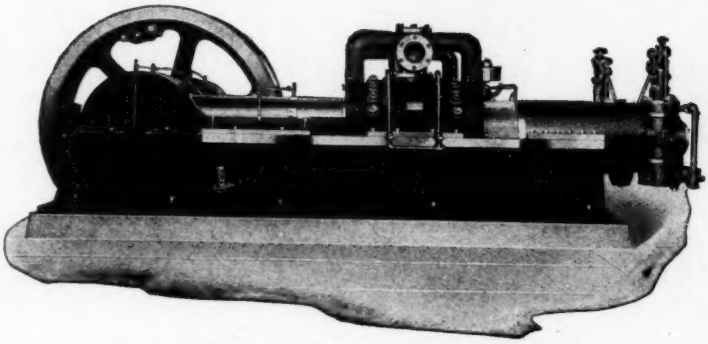
Gravity, 24.0.
Flash, 500.
Fire, 575.
Viscosity, 150@212° F.
Cold Test, 45.
Color, Light Green.

The carbon content of Nos. 3, 4 and 5 is very low. No. 3 is .014%, No. 4, .006%, and No. 5, .012%, and all pass the emulsion test O. K.

South Texas crude produces a grade of cylinder oil as follows:

Gravity, 17.5.
Flash, 450.
Fire, 510.
Viscosity, 150@212° F.
Pour, 0° F.
Color, Dark greenish blue.
This stock is made by reducing lubri-

THE NEW ENCLOSED TYPE



Direct Gas Engine Driven Vacuum Pump, Two Cylinder

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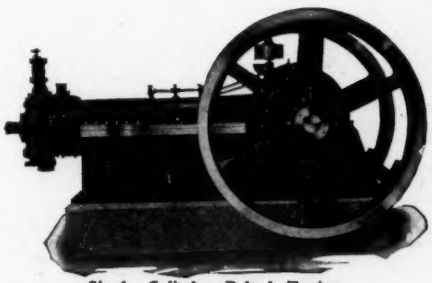
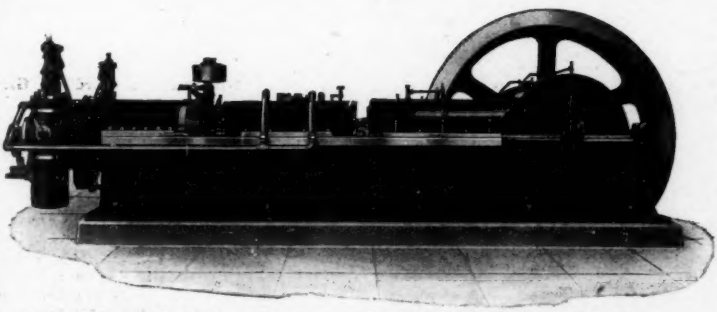
Pat. June 22, 1897; Oct. 6, 1914; April 13, 1915

High Efficiency Gas Engines, Compressors, and Vacuum Pumps for Power Plant Equipment

Sizes from 25 to 400 h. p.



Single Cylinder Belted Engine



Direct Gas Engine Driven Compressor, Two Cylinder, Single or Two Stage

Compressors particularly adapted to casing-head gasoline plants, gas pumping plants, and compressed air installations, in single and 2-stage machines to operate on practically all intake and discharge pressures. Continuous circulating filtering automatic oiling system.

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cating distillate to 150 viscosity. Two cuts are made for lubricating distillate from the crude, the first from 25.0 to 19.0, known as light lubricating distillate and from 19.0 to pitch heavy lubricating distillate.

Engine, Spindle and Auto Oils

This class of oils is produced from many crudes, in the United States from Pennsylvania, West Virginia, Ohio, Oklahoma, Kansas, Louisiana, North and South Texas, California and Illinois crudes, in Europe from Hanover, Roumanian, Italian and Russian crudes and from various Indian and Mexican crudes.

The manufacture of lubricating oils may be divided into two classes; those from paraffin base and asphalt base crude; the paraffin base will be treated first.

The first step in the production of paraffin base lubricating oils is the manufacture of paraffin distillate. The paraffin distillate is that product of distillation which distills at higher temperatures, following gas oil and continuing until the oil is of unsatisfactory color which is almost at the point of coking in the still, and contains the wax and lubricating oils.

It is necessary that the amorphous paraffin contained in the distillate is properly "cracked" and converted into crystalline or proto-paraffin in order that it may be successfully pressed.

Paraffin Distillate from Electra Crude

Grav. 29.1.

Over@275° F.		
10%	608	36.2
20	642	32.6
30	662	31.5
40	682	30.9
50	705	30.4
60	714	29.9
70	728	29.5
80	738	29.0
90	748	28.5

Bottom, 21.4

The paraffin distillate is chilled to about 10-15° F. or lower depending upon the cold test desired, and then pumped through the filter presses, the crystalline wax is retained in the presses, the wax free oil dripping through into a trough and from there led into a tank. This wax free oil is called pressed distillate and is the base of the lubricating oils.

The lubricating stills are filled to the proper outage with pressed distillate and distillation started, at about 350° F. steam is introduced through spray pipes inside and at the bottom of the still to prevent cracking and the oil either reduced to the desired test or distilled overhead down to coke or pitch.

Cuts are made for certain grades at a predetermined point. When an oil of the proper test is obtained it is called lubricating distillate and is then pumped to the agitators and given a sulphuric acid treatment and caustic soda to remove asphaltic and carbonaceous matter, after which treatment it is ready for use or if a lighter colored oil is required, it is filtered through Fullers Earth or animal charcoal.

Lubricating oil may be distilled continuously from the press distillate from paraffin base crudes or lubricating distillate from asphalt base crudes.

Five stills connected in series comprise an efficient setup. The five stills are first charged with the distillate, "fired up," and the contents of each still brought to the grade it will run when running continuously. At this point the feed pump is started to feed the distillate into the system and the residue pump also started to remove the test oil from the bottom of the last still in the set.

The first still performs the duty of a preheater, the temperature being about 250 to 300° F.

The second still is running gas oil overhead as is the third, the fourth rerun stock or light neutral, the fifth overhead, neutral about 100 vis. and the base of the fifth still 200 viscosity red.

The above is common practice when running pressed distillate from Electra crude, and may be varied within certain limits to produce oils of different viscosities.

To manufacture red oils of higher viscosity, for example, 400 viscosity red, a still is charged with 200 red, and further reduced to 400 vis.

Pennsylvania Crude

Cuts are made as follows—start 53.0—crude naphtha, 53.0 to 41.0 water white distillate, 415 to 400 300 dist. 40.0 to 34.0—37.0 distillate, 34.0 to off 34.0 distillate.

The 37.0 distillate is pressed yielding pressed oil and slack wax. The pressed oil may be run in the reducing stills as follows:

1. Overhead gas oil distillate, residue 98 vis. or

2. Overhead gas oil distillate residue —wool stock 110 vis. which is debloomed and sweetened or

3. First overhead gas oil distillate—then cut 40.0 to 34.0 at worm which is a neutral oil of 50 viscosity. This oil has a low flash and must be steamed to raise flash to 290° F. open cut and the residue is spindle oil 140/150 viscosity.

Pennsylvania Lubricating Oils

The 37.0 gravity distillate is pressed for about 20° F. cold test oil and then reduced to 98 viscosity for White Rose or to 150 viscosity for Spindle, the overhead during distillation is gas oil. While the cut from 42.0 to 35.0 gravity is 50-54 viscosity wool stock.

The 24.0 gravity distillate is distilled 85% overhead and 15% naphtha bottom. The 85% distillate is pressed yielding slack wax and pressed oil.

The pressed oil is rerun in reducing stills, the reduced oil being either 240 viscosity motor oil or 270-275 viscosity oil at 345 vis. stock as desired, while a cut is made overhead for 100 viscosity.

West Columbia Crude

The average tests of the Crude are as follows:

Gravity .....22.5 Be.
Flash .....215 O. C.
Vis. .....182 @ 100 Saybolt
Sulphur 2%
Pour 0

Lubricating oils manufactured from this crude are of good color, low cold test and high viscosity. Among other products present are Gas Oil and Asphalt, the first 30% over in distillation being suitable for Gas Oil or Fuel Oil; and the residue, which in this run is 14½% of the crude, may be used as heavy fuel alone or mixed with the 30% cut for fuel, or oxidized to asphalt of any required grade.

West Columbia crude does not contain any naphtha or kerosene obtainable by ordinary methods of distillation, as will be seen by the crude distillation, the 2½% over being only 32.5 Be. gravity. In the following distillation for lubricating oil the amount of fuel consumed under the still was from four to four and one-half bbls. per 100 bbls. of oil distilled.

Cut	%	Temp.	Grav. ity	Flash	Saybolt Vis. @ 100 F	Cold Test
1	2½	436°F	32.5	...	...	0
2	"	496	30.7	155	34	0
3	"	528	29.7	175	35	0
4	"	550	29.1	190	37	0
5	"	570	28.7	195	38	0
6	"	584	28.6	215	39	0
7	"	592	28.1	220	40	0
8	"	594	27.7	225	41	0
9	"	596	27.4	235	43	0
10	"	598	27.2	240	44	0
11	"	600	27.0	245	45	0
12	"	608	26.8	245	46	0
13	"	612	26.6	250	48	0
14	"	614	26.1	250	52	0
15	"	615	25.7	265	54	0
16	"	617	25.4	275	59	0
17	"	618	24.9	280	65	0
18	"	619	24.7	280	71	0
19	"	619	23.8	295	80	0
20	"	619	23.8	305	87	0
21	"	620	23.5	315	105	0
22	"	621	23.5	320	120	0
23	"	622	23.2	335	153	0
24	"	622	22.9	335	169	0
25	"	623	22.1	345	207	0
26	"	628	21.9	355	253	0
27	"	630	21.3	370	331	0
28	"	636	20.7	375	420	0
29	"	640	20.4	385	531	0
30	"	644	20.0	400	763	0
31	"	650	19.8	415	1000	0
32	"	656	19.7	425	1171	0
33	"	658	19.6	440	1575	0
34	"	662	18.9	453	2255	0

Loss in distillation .5%, bottom 14.5% of crude, gravity 15.5, Flash 485, Fire 635.

Gas Oil

Cuts 1-12 inclusive mixed for Gas oil with the following tests:

Gravity 28.7
Flash .....178 P. M.
Sulphur ..... .070%
Pour ..... 0°F
BTU 19,460
BTU per gal. 143,107

The gas oil is a valuable fuel and may, on account of its low sulphur and paraffin content be mixed with other fuels of high sulphur and paraffin conent, the proportionate amounts of each fuel being so arranged as to produce a fuel of medium sulphur content and cold test.

Lubricating Distillate

Cuts 13-34 inclusive for lubricating distillate or the cut by gravity would be from 26.8 to 18.9 Be., this amounts to 55% of crude and tests as follows:

Gravity ..... 23.0 Be.
Flash ..... 310° F. O.C.
Viscosity .....163 @ 100
Pour ..... 0° F.

The lubricating Distillate is then rerun over lye—i.e. 2% by volume of 30 Be.

It Pays to Advertise

In the REFINER and NATURAL GASOLINE MANUFACTURER

LAST month, within two days of the time when the first issue of the Refiner and Natural Gasoline Manufacturer reached Chicago, one of the advertisers in it received a nice order from one of the biggest refining concerns in Chicago. And the order showed that the purchasing agent, or the refinery superintendent who sent in the requisition, had seen the advertisement in The Refiner.

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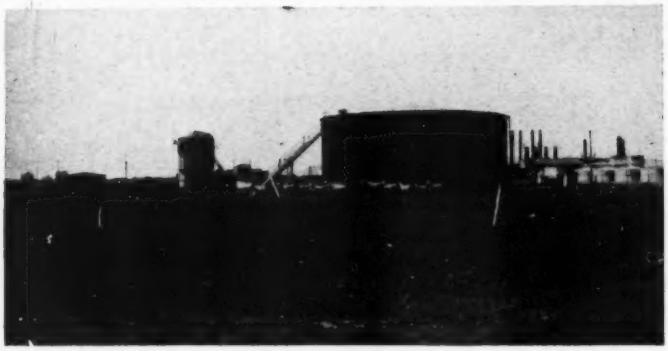

The purchase of an even dozen goats with an inexhaustible appetite for tall grass and weeds was made recently by the Panhandle Refining Company from a North Texas farmer to be used in holding down the costs of keeping its refinery and tank farm reservation cleared of rubbish as well as grass and weeds. The idea was conceived by J. B. Fletcher, crude buyer for the company and who is often spoken of by his co-workers as the "Goatherder." Fletcher is proud of his herd and is already making arrangements to supply other refineries nearby with a heard or two by next spring from the stock of "kids" that are assured by that time. Preparations are being made to put guards on the tanks and stills if the goats become too frolicsome, or forsake their vegetable diet for heavier substances.

Caustic Soda solution is mixed in the still with the distillate.

Rerun of Lubricating Distillate

Cut	%	Temp.	Grav. ity	Flash	Saybolt Vis. @ 100 F	Cold Test
1	10	536°F	27.5	230	49	0
2	"	540	26.2	260	58	0
3	"	555	25.0	295	76	0
4	"	575	24.2	325	95	0
5	"	585	23.3	340	148	0
6	"	605	22.6	360	244	0
7	"	615	21.6	385	436	0
8	"	621	20.7	400	797	0
9	"	628	20.3	410	1275	0
10	"	642	19.9	430	1981	0

The first two cuts being valueless as lubricants were added to the gas oil previously mentioned giving total gas oil yield of 41% of the following tests:

Gravity, 28.1
Flash, 188 P. M.
Sulphur, .074
Pour, 0°F.

Various mixtures may be made for lubricating oils of different viscosities, mixture of cuts No. 4-7 inclusive, treated with 10-lbs. 66 acid (sulphuric) yields a pale oil of the following tests:

Gravity, 23.0
Flash, 330 O. C.
Viscosity, 128 @ 100
Pour, 0°F.
Color, 1½ N.P.A.

Treating loss 1.925% of Crude. Finished oil 25.575% of crude. Cuts No. 4-10 inclusive, treated with 10 lbs. 66 sulphuric acid per bbl.

Gravity, 21.9
Flash, 370 O.C.
Viscosity, 312 @ 100
Pour, 0
Color, 2 N. P. A.

Treating loss 3.08% of crude. Finished oil 35.42% of crude. Cuts 8 and 9 treated with 10 lbs. per bbl. 66 sulphuric acid.

Gravity, 20.5
Flash, 405 O. C.
Viscosity, 85 @ 100
Viscosity, 61 @ 212
Pour, 0
Color, 2½ N. P. A.

Treating loss 1.1% of crude. Finished oil 9.9% of crude. Cuts 8-10 inclusive, treated with 10 lbs. per bbl., 66 sulphuric acid.

Gravity, 20.0
Flash 415 O. C.
Viscosity, 186 @ 100
Viscosity, 74 @ 212
Pour, 0
Color, 3 N.P.A.

Treating loss 2.5% of crude. Finished oil 14.0% of crude.

All the above oils are of very good appearance, pale yellow by transmitted light and green by reflected light.

Residue

From the crude run, amounting to 14½% of crude if not added to the gas oil as fuel may be oxidized to asphalt. In this case the asphalt which was of 170° F. M. P. R. & S. penetration 43 @ 77° F., ductility 4 c. m. @ 77°F., fixed carbon 16.3%, Ash .21%, Flash 520° F., Fire 500° F. , soluble in CS_2 99.76%, solubility in Cc14 99.64%, evaporation five hours at 320° F., 15%. Loss during oxidation 25%, which is 3,625% of the crude, oxidation is carried out by blowing air thru the asphaltum oil in a suitable container until the oil is converted into asphalt or any desired test, samples for test being drawn out at regular intervals during oxidation.

Test Run for Cylinder Oil

Separate portions of crude were treated in an attempt to make cylinder oil therefrom. The crude before treating:

Gravity, 22.5 Be.
Flash, 215
Viscosity, 182 @ 100
Sulphur, .2%
Pour, 0° F.

Treated with 30 lbs. per bbl. in two separate dumps, 3 lbs. each, the crude after treating:

Gravity, 24.2
Flash, 235 O. C.
Viscosity, 144 @ 100
Sulphur, .190%
Pour, 0

The treated crude reduced for cylinder stock, overhead 61.5% of crude:

Gravity, 19.5
Flash, 150 P. M.
Viscosity, 48 @ 100
Pour, 0

Cylinder Stock Residue; 38% of crude:

Gravity, 19.5
Flash, 445
Fire, 515° F.
Viscosity, 146 @ 212
Pour, 0
Color, Dark Green
Loss in distillation .5% of crude.

Total Percentages—

Gas Oil	46.500%
320 Vis. Pale	35.420%
Tr. Loss	3.080%
170 M.P. Asphalt	10.875%
Loss Oxidizing	3.625%
Distillation Loss	.500%
	100.000%

West Columbia also yields an ice machine oil of very low cold test.

Lubricating Oils from Humble Crude

The crude is distilled in the presence of steam and all distillates from 25.0 gravity at the worm to residue pitch in the still is included in the lubricating distillate and amounts to 42 per cent of the crude.

The lubricating distillate is then redistilled in the presence of from two to four per cent by volume of 30° Be., caustic soda solution.

All the distillate from start to 23.5 gravity at the worm is returned to gas oil and from 23.5 to 21.5 gravity and 20.0 gravity to pitch in still is classed as red oil, while the middle cut from 21.5 to 20.0 is pale oil.

The red oil tests as follows:

Gravity, 21.2 Be.
Flash, 335° F. open cut.
Viscosity, 207@100 Saybolt.
Cold test, 0° F.

The pale oil:

Gravity, 20.6 Be.
Flash, 385° F. open cup.
Viscosity, 358@100 Saybolt.
Cold test, 0° F.

The lubricating oil may be made directly from the crude without rerunning by distilling the crude over 5 per cent of 30° Be. caustic soda solution and with a maximum amount of bottom steam a yield of 30 per cent of the crude being recovered with the following tests after treating with 15 pounds per barrel of 66 surphuric acid.

Gravity, 21.1 Be.
Flash, 360 open cup.
Viscosity, 288@100 Saybolt.
Color, 3½.
Cold Test, 0° F.

The yield of lubricating oils from Goose Creek crude is practically the same as that of Humble crude and the quality of the products almost identical.

Use of Caustic Soda Solution

Caustic soda is used in quite a number of asphalt base crudes or their distillates during distillation for lubricating oils.

The caustic soda neutralizes practically all petroleum acids, destroys surphuric compounds, etc., which may be present but at the same time has very little effect on the alkyl sulphide.

It is a noticeable fact that all of these

As readers of the old reliable OIL WEEKLY for several years, we wish to congratulate The Gulf Publishing Company on its forward step in establishing a specialized publication for the refining and natural gasoline trade, The REFINER AND NATURAL GASOLINE MANUFACTURER, and to wish for that publication the successful career we are sure it will enjoy.

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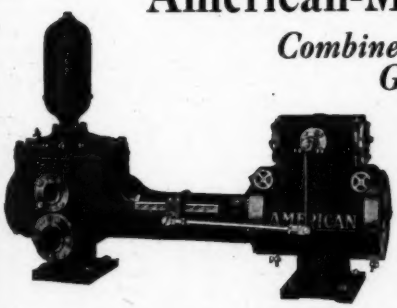

American-Marsh Pumps meet the demand for strictly high grade high efficiency units where absolute reliability over a long term of years is essential. Their heavy, rugged construction with extra wide passages and large valve areas make them ideal for handling oil and other heavy liquids.

The steam pumps are fully bronze fitted. Heavy cradle yokes are furnished between steam and water ends instead of tie rods, making expensive drip pans unnecessary.

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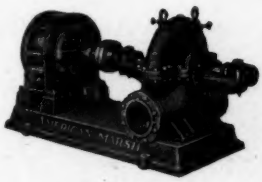

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Vacuum Pumps	Centrifugal Pumps
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Refiners Take Up Fight on Patent Trouble

Resolutions adopted at seventeenth meeting of National Petroleum Association

ATLANTIC CITY, N. J., Sept. 24.—At the seventeenth annual meeting of the National Petroleum Association held here September 20 to 22, eastern refiners attending the gathering gave over much of the meeting to the discussion of existing trouble over patents on the cracking process and were unanimously in favor of immediate action for settlement.

The course of action decided upon by the majority of those attending was to appeal to the attorney general of the United States to bring suit in behalf of the public to define the basic patents on the process and to annul any existing patents that may be illegal.

The board of trustees of the association was instructed to take up immediately the matter of straightening out the present trouble and take any action which they decide upon that will quickly bring the dispute to an end.

In his annual report General Counsel C. D. Chamberlin stated that the fact that the cracking processes were in the hands of the major companies which have threatened suit for damages upon smaller concerns has intimidated these smaller companies from using other available processes.

Judge Chamberlin in his report also stated that the last word was with the courts and it was impossible to predict whether all of the claims of the patents in the hands of the larger companies would be finally sustained or not.

Suits now existing as pointed out by Judge Chamberlin are the so-called Dubbs' interests against the Standard Oil Company of Indiana for alleged infringement of the Burton process upon the Dubbs' process; the suit of the Standard Oil Company of New Jersey against the Pure Oil Company for alleged infringement of the Ellis process by the Cross patent, used by the Pure Oil Company upon the Ellis patent. Several other suits of minor importance were also mentioned and it was stated that a number of other ones are now being prepared.

H. H. Willock of the Waverly Oil Works of Pittsburgh, Pennsylvania, made the motion that the trustees start action against the tangle at once and several discussions were made from the floor in favor of the motion.

The meeting was held at the Traymore hotel and was attended by a representative gathering of refiners from practically every portion of the eastern refining territory. General Counsel Chamberlin opened the meeting with a report on the growth of the organization and the various results accomplished throughout the past seventeen years. Judge Chamberlin pointed out the good work carried on during the past two years in spite of the fact that the industry was experiencing its worst depression.

At the first session those in attendance were entertained by the Union Petroleum Company at a luncheon served at the Sea View Golf Club.

Prepared reports were received from the various departments and the business of the organization was taken up. Col. U. G. Lyons, president of the Conewango Refining Company was again selected as president of the association. Col. Lyons has held this position for a number of terms now. C. L. Suhr, president of the Penn American Refining Company, was elected first vice president and P. M. Miskell, general manager of the Empire Refineries, Inc., was elected second vice president. Otto Koch, president of the Kendall Refining Company, was re-elected as treasurer, while Herbert G. Eaton of the Superior Oil Works, was returned as recording secretary. General Counsel Chamberlin, Traffic Manager F. W. Boltz and Washington Counsel Fayette B. Dow, were also re-elected.

New additions to the board of trustees were made in the following: G. B. Hunter, assistant treasurer of the Emlenton Refining Company; L. R. Crawford, president of the Paragon Refining Company; L. B. Cuddy, president of the Vulcan Oil Refining Company; Fred G. Clark, president of The Fred G. Clark Company, and Harry L. Deming, general manager of the Petroleum Refining Company.

Reports received from the departments at the three-day session were given as follows: Manufacturers, Otto Koch, Kendall Refining Company; Standards and Tests, O. P. Keeney, Tide Water Oil Company; Traffic and Transportation, W. E. MacEwen, National Refining Company; Trade and Commerce, A. C. Woodman, Union Petroleum Company; and the report of President Houston Dunn of the National Petroleum and Mutual Fire Insurance; Economics, Accounting and Statistics, George N. Moore, Moore Refining Company; Legislation and Litigation, Sheldon Clark, Sinclair Refining Company; Membership and Relations, H. A. Logan, United Refining Company; Welfare and Insurance, C. B. Dallm, Pittsburgh Oil Refining Company.

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oils when run over lye are easily treated in the agitators and not readily emulsify, which is not the case with the same oils should the caustic soda be omitted.

Some trouble may be experienced in removing the pitchy residue from the stills on account of its sticky nature, which defies the usual still cleaning methods used to remove coke.

The difficulty may be overcome by shutting off the steam into the stills just before the residue reaches the pitchy stage or when all the lubricating oil of quality has been distilled off, the still temperature being great enough at this time to produce cracking and thereby breaking down the impending pitch into light oil, which leaves the still overhead through the condenser in the usual manner and is led into gas oil distillate tank, leaving a dry coke residue which is easily removed.

Distillation of Lubricating Distillates

Stills used for this purpose must be equipped with adequate steam sprays as the prevention of cracking is of utmost importance in the manufacture of lubricating oils. If by any chance the steam is stopped during the distillation of lubrication oil and especially near the end of a run when the still is at its highest temperature, cracking will almost immediately occur and loss of color, flash and viscosity of the distilled product ensues, which cannot be regained even though a maximum amount of steam be again introduced. The result of such action may be noted by the following run on the previously mentioned West Columbia lubricating distillate which indicates the viscosities of the 10 per cent fractions when distilled normally and when the steam is stopped.

Normal Distillation

Cut	Per Cent	Temp.	Grav.	Flash	Vis.
1	10	536	27.3	230	49
2	10	540	26.2	260	58
3	10	555	25.0	295	76
4	10	575	24.2	325	95
5	10	585	23.3	340	148
6	10	605	22.6	360	244
7	10	615	21.6	385	436
8	10	621	20.7	400	797
9	10	628	20.3	410	1275
10	10	642	19.9	430	1981

Steam Stopped During Distillation

Cut	Per Cent	Temp.	Grav.	Flash	Vis.
1	10	536	27.3	230	49
2	10	540	26.2	260	58
3	10	555	25.0	295	76
4	10	575	24.2	325	95
5	10	585	23.3	340	148
6	10	605	22.6	345	*244
7	10	615	21.8	310	290
8	10	625	22.0	290	282
9	10	640	22.6	270	260
10	10	656	24.2	200	178

*Steam stopped at this point.

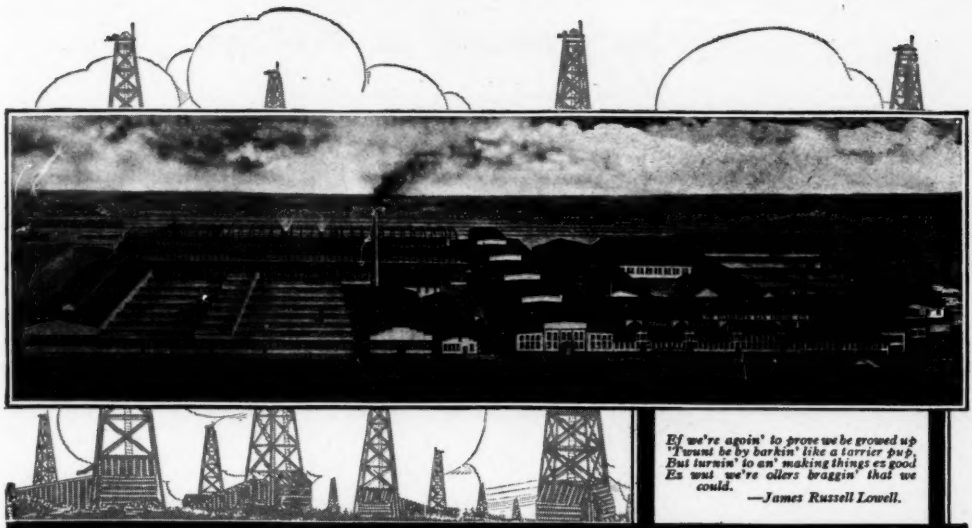
Cracking may also be produced by driving the still too hard, when the evolved vapors do not have sufficient time to leave the still, and when the oil is superheated locally.

A still may be driven above its capacity provided the temperature is not brought up unreasonably high and a maximum amount of steam carried, if the still is provided with adequate vapor lines.

E. R. Lederer, former consulting petroleum engineer, has been elected vice president of the Invincible Oil Corporation and the Louisiana Oil Refining Corporation in charge of refineries. His headquarters will be at Shreveport.

Houston, Texas, Aug. 15.—Keen and Woolf is erecting three 2200-barrel storage tanks at their Houston plant. The tanks will be used for lube oil storage.

XUM



Ef we're agoin' to prove we be growed up
'Twunt be by barkin' like a tarrier pup;
But turnin' to an' making things ez good
Ez wut we're allers braggin' that we could.

—James Russell Lowell.

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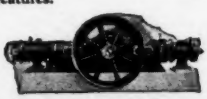

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Use of Sulphur Dioxide in Treating Oils

Results obtained through use of the processes of Edeleanu, Bowery, etc.

By Moore, Morrell & Egloff *

In the analysis and refining of oils, the question of procedure has long been a vexed one. Methods for the determination and isolation of the various constituents of natural petroleums and artificial oil mixtures follow no general scheme and are of questionable accuracy. The well known sulphonation of olefins and nitration for aromatics have long been used as more or less approximate tests for the want of something better. Moreover with this method the unsaturated and aromatic hydrocarbons are lost, since their recovery from the acid sludge is difficult, and their physical properties therefore are based on calculation of the oil before and after treatment, giving questionable results. The present paper is a contribution to the analytical and refining methods of hydrocarbon oils, based on their solubilities in liquid sulphur dioxide.

In 1892 Walden used liquid sulphur dioxide as a solvent for many inorganic and organic substances, dissolving among others, benzene, phenol, naphthalene, aniline and diphenylamine. This property of liquid sulphur dioxide to dissolve certain organic substances was used by Edeleanu in the refining of crude petroleums. He found that "if a distillate is agitated with liquid sulphur dioxide at a low temperature the aromatic compounds are dissolved but the paraffins and naphthalenes are unaffected." With this as a basis he evolved the process bearing his name, which has been used to some extent in Italy and Germany. In his paper Edeleanu shows the efficacy of his process in refining many illuminating oils and compares results with the ordinary methods of refining. He finds also that liquid SO_2 has marked effect in removing certain sulphur bearing compounds along with the aromatics.

The admirable work of S. E. Browery takes up the refining with liquid sulphur dioxide in more detail. Using Edeleanu's method at 12° C. Browery found that conditions applied to purifying lamp oil do not hold for lighter fractions. For example, at —12° C. the lamp oil fraction from a Trinidad crude, treated three times with half its volume of sulphur dioxide gave highly satisfactory separation. On the other hand a light distillate (up to 150° C.) from the same crude yielded extracts containing about equal parts of aromatics and paraffins. By working at lower temperatures than —17° C. it was found possible to improve results up to a point at which satisfactory correction could be applied by means of specific gravity determinations. A series of extractions run on artificial mixtures containing about 15 per cent aromatics and using temperatures to —35° C. (obtained by evaporating liquid SO_2) showed fairly accurate results. The method was applied to the determination and recovery of toluene in crude oil from Trinidad Central. Browery states that "naphthenes are insoluble in SO_2 and are therefore left with the paraffins."

Rittman and Moore in 1915 published a note on the liquid SO_2 method of separating aromatics from paraffins. Their results show fairly good separations for low percentages of aromatics but not on higher percentages. In their work which was merely a preliminary note on method, the burette was embedded in ice and salt mixture and its removal for volume reading took time and made temperature readings uncertain.

Scope of Work

The literature contained no work on the individual solubility in liquid sulphur dioxide of the various hydrocarbons. As this seemed essential to any comprehensive work the curves of various pure compounds were determined. The results on naphthenes were contrary to the statement of both Edeleanu and Browery and are discussed later. The solubility of the following hydrocarbons was determined: Pentane plus hexane, hexane, octane, nonane plus decane; washed gasoline, washed kerosene; benzene, toluene, xylenes, mesitylene; hexalene, caprylene; cyclohexane and naphthenes boiling within the following limits, 75-155°, 155-175°, 175-185°. These solubilities were determined at temperatures of —10° C. and —18° C. A series of SO_2 treatments was then run on a number of synthetic mixtures and results tabulated.

Hydrocarbons Used

The physical properties of the oils used are given in groups in table I.

The cyclohexane was particularly pure specimen melting at 6.4° C. The sulphuric acid and nitration tests showed no trace of either olefins or aromatics, and the absence of paraffins was sufficiently proven by its specific gravity, index of refraction and sharp freezing point.

The higher boiling-point naphthenes used were distilled from naphthene-base oil distillates. The following fractions were used: boiling points 75 to 155°, 155 to 175°, and 175 to 185°. These were washed free from olefins and aromatics. The specific gravity and index of refraction of these fractions indicate their naphthenic nature. In Table II these values are compared with the physical properties of pure paraffins and pure naphthenes.

Table I—Paraffins

Name	B. P. °C. Below	Sp. Gr. (Westphal) 15.5° C.	(Pulfrich) Index	Treatment with Conc. H_2SO_4 & Conc. HNO_3
Petroleum Ether (Butane, Pentane & Hexane)	50	0.643	1.3629	No coloration
" "	55-65	0.650	1.3700	" "
Hexane	68.8	0.655	1.3734	" "
Octane	125.4-125.6	0.706	1.3999	" "
Nonane and Decane	156-159	0.730	1.4174	" "
Gasolene X	57-175	0.721	1.4008	" "
Kerosene X .....120-250—89%		0.779	1.4277	" "
Aromatics				
				Remarks
Benzene	80.2-80.4	0.880	1.5014	No coloration
Toluene	109-110.2	0.870	1.4982	with 1.84 H_2SO_4
Xylene (p-xylene)	138	0.880	1.4961	"
Olefins				
Hexylene	68	0.689	1.3994	Combined completely
Octylene	121-124	0.724	1.4145	with 1.84 H_2SO_4
Naphthenes				
Cyclohexane, 6.4° M. P. ...	80-80.2	0.780	1.4255	No coloration with
Naphthenes	75-155	0.784	1.4267	H_2SO_4
"	155-175	0.799	1.4345	or
"	175-185	0.809	1.4379	HNO_3

X—The gasoline and kerosene were distilled from Pennsylvania crude, washed repeatedly with fuming sulphuric acid, neutralized with dilute sodium hydroxide, washed with water and dried over calcium chloride.

Table II

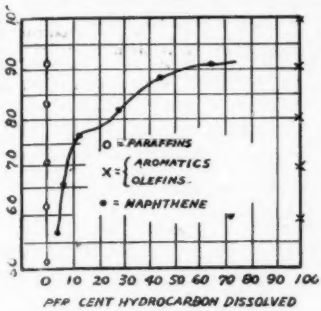
Boiling Point Range °C.		Pure Paraffins	Pure Naphthenes	Oil Used
75-155	Sp. Gr.	0.712	0.778	0.784
	Index	1.411	1.429	1.4267
155-175	Sp. Pr.	0.730	0.798	0.799
	Index	1.413	1.44	1.4345
175-185	Sp. Gr.	0.745	0.803	0.809
	Index	1.4158	1.433	1.4379

The paraffin and naphthene hydrocarbons are almost identical in their inactivity toward reagents, and therefore offer difficulty in distinguishing one from the other. But if we know that an oil is free from olefins and aromatics, through sulphonation and nitration, specific gravities and refractive indices are sufficiently wide apart to distinguish pure naphthenes from pure paraffins. The above table shows that in each case the properties of the oil used closely approximated values for the pure naphthenes, and were sufficiently higher than the value for paraffins to assure absence of the latter. The difference in their behavior with the liquid sulphur dioxide checked up their difference in chemical structure.

Solubility of Aromatics in Liquid SO_2

The solubility of pure aromatic hydrocarbons in the liquid SO_2 is shown in

Graph I. Two different percentages of liquid SO_2 were used, 33.3% and 66.7% and two temperatures, —18° C. and —10° C. The four aromatics used, benzene, toluene, xylene and mesitylene were completely miscible in all cases. In using the benzene which freezes at 6° the SO_2



Graph I

was run into the kerosene at room temperature, shaken and then placed in the bath. With 33.3% SO_2 only a slight turbidity was visible due to a tendency of the benzene to freeze.

Solubility of Paraffins in Liquid SO_2

The insolubility of paraffin hydrocarbons is shown in Graph I. Pentane plus hexane, hexane, ocane, nonane plus decane, gasolene and kerosene are shown to be insoluble at —18° and —10° and with varying proportions SO_2. With kerosene at —18°, from 33.3% to 98% SO_2 were used. The relative solubility of the liquid SO_2 in paraffins was determined ranging from an unmeasurable quantity at —18° to 1.8% at —10° for the low boiling point members and increasing in solubility to 3.6% in the higher boiling kerosene oil. There was in no case an indication of paraffins appreciably dissolving in the liquid sulphur dioxide.

Solubility of Olefins in Liquid SO_2

The solubility of olefins in liquid SO_2 is shown in Graph I. The behavior at —18° and —10° for 33.3% and 66.7% liquid SO_2 corresponds to that of the aromatics, namely, entire miscibility.

Solubility of Naphthenes in Liquid SO_2

The solubility of naphthene hydrocarbons is shown in Graphs I and II. Edeleanu (loc. cit.) and Browery (loc. cit.) both state that naphthenes are entirely insoluble in liquid sulphur dioxide and after treatment are left with the paraffins. The present work, however, indicates that naphthenes vary in solubility from 0 to 100% depending on the temperature and concentration of the liquid SO_2. Graph II shows the solubility of pure cyclohexane at temperatures of —18°, —10°, —7.5° and —4.5° C. and at percentages SO_2 ranging from 45 to 91. Below 45 per cent SO_2 that is, nearly an equal volume, there is no solubility at —18° and only 3 per cent at —4.5° C. With about 70% SO_2 however, the solubility shows a marked increase. The solubility also increases rapidly with temperature; with 89.4% SO_2 the solubility is about 58% at —18° and 100% at —4.5° C. One marked peculiarity of the naphthene action with SO_2 is that as the concentration of SO_2 reached a point between 83% and 87% white crystals appeared in the oils, remaining upon addition of more SO_2.

Table III. Solubility of Naphthenes in Liquid Sulphur Dioxide

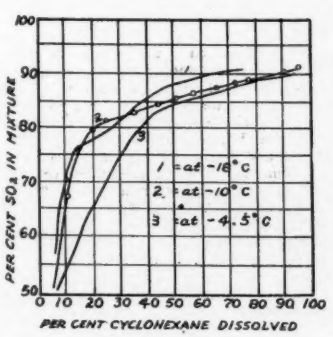
B. P. of Naphthenes Used	Temp. °C.	Percent SO_2 Used	Percent Naphthene Dissolved
175-185°	—10	50.0	0.0
175-185°	—10	67.0	0.0
175-185°	—10	75.0	0.0
175-185°	—10	80.0	0.0
175-185°	—10	81.8	4.0
175-185°	—10	83.3	6.0
175-185°	—10	85.5*	13.0
175-185°	—10	87.5	16.5
175-185°	—10	88.5	23.0
75° C-155° C	—10	50.0	0.0
75° C-155° C	—10	67.0	0.0
75° C-155° C	—10	75.0	4.0
75° C-155° C	—10	80.0	8.0
75° C-155° C	—10	83.3*	14.0
75° C-155° C	—10	83.9	15.0
75° C-155° C	—10	85.5	23.0
75° C-155° C	—10	87.5	30.0
75° C-155° C	—10	88.5	37.0

*Crystals formed.

Table IV.—Solubility of Naphthenes at Varying Temperatures

	—18° C.		—10° C.		—0° C.	
	% SO_2	% Dissolved	% SO_2	% Dissolved	% SO_2	% Dissolved
155-175°	50.0	0	50.0	0	50.0	0
155-175°	66.7	0	65.7	0	66.7	0
155-175°	75.0	0	75.0	0	75.0	0
55-175°	80.0	0	80.4	2	80.0	2
155-175°	83.0	2	81.8	7	81.5	8
155-175°	84.4	5	84.1	9	83.1	11
155-175°	86.9	5	86.5	12	84.9	15
155-175°	87.2	6	87.3	14	86.3	20
155-175°	89.2	18	87.8	17	87.35	24
155-175°	90.5	25	88.6	19	88.9	28
155-175°	*	*	88.9	20	89.25	30
155-175°	*	*	89.4	22	89.5	32
155-175°	*	*	90.0	28	90.2	39

*Remainder dissolves when warmed.

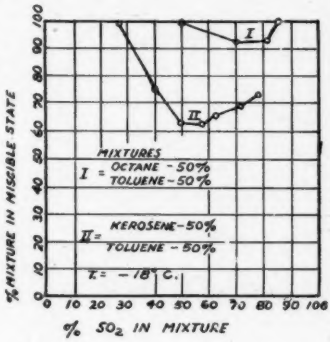


Graph II

At this cone, SO_2 white crystalline solid appears in oil and remains.

Per Cent Hydrocarbon Dissolved

This peculiarity of behavior together with the rather marked increase in solubility at about 70 per cent SO_2 seems to point to some compound between the SO_2 and the naphthenes. The literature contains examples of compounds forming between liquid SO_2 and organic substances. For instance, De Bruin, mixed isoprene with an equal volume liquid SO_2 and obtained a crystalline compound of the composition $C_5H_8SO_2$ of definite melting point, 62.5° Baume and Pamfel working with liquid SO_2 and methyl alcohol found indications of the formation of $CH_3OH.SO_2$ and 2 CH_3OH-SO_2. The case in question does not seem to be plain solubility but probably formation of a



Graph III

compound which is stable only at low temperatures and in the presence of considerable SO_2.

The naphthenes of higher boiling point (tables III and IV) show a much smaller solubility than cyclohexane. The fraction 175°-185° is insoluble up to 80 per cent SO_2 but shows a marked increase from there on, giving a solubility of 23 per cent upon the addition of only 8.5 per cent more SO_2.

One of the difficult problems heretofore in oil work has been the determination of naphthenes in the presence of paraffins. The usual method has been merely a calculation based on the boiling point, index and specific gravity of the unvitratable oil; while Kramer and Bottcher's method involves fractionation to within one or two degrees and carbon and hydrogen determinations of these fractions to estimate naphthenes present. These methods are proximate at best, the second one involving considerable manipulation. The action of liquid sulphur dioxide therefore may prove a valuable aid not only in estimating naphthenes in paraffins but separating them for further test.

Action of Sulphur Dioxide on Synthetic Mixtures

The work on synthetic mixtures is divided into six sections, as follows:

A. Paraffin-aromatic mixtures
B. Naphthene-aromatic mixtures
C. Paraffin-olefin mixtures
D. Paraffin-naphthene mixtures
E. (a) Olefin-naphthene mixtures
   (b) Olefin aromatic mixtures
F. Paraffin-aromatic-olefin mixtures

A.—Paraffin-Aromatic Mixtures

Benzene-hexane, table V.
Toluene-actane, table VI.
Toluene-Octane, table VI.

Although the aromatic oils are entirely

Table V.—Separation of Paraffin-Aromatic Mixtures

Benzene, specific gravity 0.880, index of refraction 1.5014.
Pentane and Hexane, specific gravity 0.650, index of refraction 1.3700.

Temp. °C.	Mixture Percent Paraffin	Mixture Percent Benzene	Percent Mixture Used	Percent SO_2 Added	Percent of oil Mixture Dissolved	Index	Dissolved Percent Benzine Calculated	Undissolved
—18	95	5	50	50	5.0	1.4860	88.3	1.3741
—18	90	10	50	50	15.0	1.4786	82.6	1.3753
—18	85	15	50	50	28.5	1.4705	76.5	1.3770
—18	80	20	50	50	32.5	1.4593	67.9	1.3814
—18	50	50	50	50	100.0	.....	...	.....

Table VI.—Paraffin-Aromatic Mixtures

Toluene, specific gravity 0.870, index of refraction 1.4982.
Octane, specific gravity 0.706, index of refraction 1.3999.

Temp. °C.	Percent Octane in Mixture	Percent Toluene Mixture	Percent of Mixture Used	Percent SO_2 Used	Percent of oil Mixture Dissolved	Index of Undissolved Oil	Index of Dissolved Oil
—18	95	5	50.0	50.0	1.5	1.4002	1.4600
—18	90	10	50.0	50.0	5.0	1.4075	1.4694
—18	85	15	50.0	50.0	14.5	1.4040	*1.4792
—18	80	20	50.0	50.0	19.0	1.4018	1.4688
—18	75	25	50.0	50.0	27.0	1.4024	1.4554
—18	50	50	50.0	50.0	100.0	.....	.....
—18	50	50	30.0	70.0	92.5	.....	.....
—18	50	50	18.5	81.5	93.0	.....	.....
—18	50	50	15.2	84.8	100.0	.....	.....

*86.8% Toluene

Table VII—Paraffin-Aromatic Mixtures

Kerosene—Specific gravity 0.779, index of refraction 1.4277.
Toluene—Specific gravity 0.870, index of refraction 1.4982.

Temp. °C.	Percent Kero- sene in Mixture	Percent Toluene Mixture	Percent of Mixture Used	Percent SO_2 Used	Percent of oil Mixture D.ssolved	Index of Dissolved Oil	Index of Undissolved Oil
—18	90	10	50.0	50.0	5.5	1.4732	1.4311
—18	85	15	50.0	50.0	14.3	1.4794	1.4308
—18	80	20	50.0	50.0	19.0	1.4813	1.4302
—18	75	25	50.0	50.0	22.0	1.4789	1.4312
—18	95	5	54.0	46.0	2.5	.....	.....
—18	95	5	39.2	60.8	6.5	1.4659	1.4285
—18	95	5	33.3	66.7	10.0	.....	.....
—18	95	5	19.5	80.5	20.0	.....	.....
—18	95	5	15.0	85.0	20.0	1.465	1.4782
—18	95	5	19.0	81.0	20.0	.....	.....
—18	50	50	73.0	27.0	100.0	.....	.....
—18	50	50	59.4	40.6	74.5	.....	.....
—18	50	50	50.6	49.4	62.5	.....	.....
—18	50	50	41.7	58.3	62.3	.....	.....
—18	50	50	38.0	62.0	65.0	.....	.....
—18	50	50	29.1	70.9	68.7	.....	.....
—18	50	50	22.6	77.4	72.6	1.4715	1.4494

paraffin oils are insoluble, the paraffin-aromatic mixture treated with the solvent presents many complexities. In the first place, the system aromatic-sulphur dioxide has a capacity for dissolving paraffins which sulphur dioxide alone has not. This is shown in the above tables by the increasing solubility of the paraffins as the percentage of aromatics in the mixture is increased. With 50% benzene present, the paraffin-aromatic mixture is 100% soluble. This is true also for the toluene-paraffin mixtures. The extraction of aromatics by sulphur dioxide is, therefore, limited to mixtures containing below 50% aromatics, and efficient extraction is possible only below 25% aromatics. Table V shows that from a mixture containing only 5% benzene, it is possible with one extraction to separate an oil of 88.3% benzene content, using an equal volume of sulphur dioxide. The percentage of benzene content is calculated, in each case, from the index, of refraction, using the formula

$$\frac{(m-p)100}{a-p} = \%\ \text{aromatics}$$

Where m—index of mixture
p—index of paraffins used
a—index of aromatics used

As the percentage of benzene in the original mixture is increased, the solubility of the mixture rapidly increases, the bulk of the aromatics being extracted. With 15% benzene in the mixture it is possible to separate nearly all the aromatics, the extraction representing 76.5% benzene. Both the toluene and benzene mixtures show best extractions when the aromatics are present to an extent not exceeding 20 to 25%. Certain natural petroleums which contain aromatics usually are under 15% in aromatics content, and therefore lend themselves admirably to the sulphur dioxide extraction. This ideal percentage of about 15% aromatics was used by Browery (loc. cit.) in extractions with sulphur dioxide and yielded satisfactory results, especially when a number of extractions were made, using each time small quantities of the solvent.

In table VI, a mixture containing 15% toluene and 85% octane yields an extraction equal to 14.5% of the entire volume. The index of this extraction denotes 86.8% toluene. This is a little better extraction than can be obtained from a kerosene-toluene mixture which under the some conditions yields a 73.3% toluene in one extraction. By extracting a number of times with small quantities of the solvent, much purer aromatics may be separated.

The effect of extracting with various concentrations of the solvent, keeping the concentration of the mixed oils constant, led to interesting results which should receive discussion. Table VII shows that using a constant mixture of 95% kerosene and 5% toluene, and increasing the amount of sulphur dioxide added from 50% to 85% ,the amount dissolved increased to a maximum of 20% with 80.5% solvent. Further addition of sulphur dioxide effected no further dissolving. A marked peculiarity in behavior, however, was noticed on 50% mixtures of kerosene and toluene with increasing addition of solvent. With 27% solvent the mixture was completely soluble. As the amount of solvent increased, less and less of the mixture dissolved until at 58.3% solvent, a minimum solubility of 62.3% of oil was reached. With further addition of solvent, the solubility increased. This peculiar behavior is also shown by the octane-toluene mixtures and is deemed sufficiently interesting to be shown graphically in Graph III. This retrograde solubility is evidence of the complexity of the aromatic-paraffin-sulphur dioxide system, a three-component system, for starting with a homogeneous system we pass to a heterogeneous system and finally to a homogeneous system again, merely by altering one concentration.

In tables V, VI and VII, the purity of the dissolved and the undissolved oils can be ascertained by comparing their indices of refraction with the indices of the original oils as given under the heading of each table. For instance, in Table VI, the indices of the undissolved oils, in each case, are very close to the value for the pure octane, i. e., 1.3999, showing that virtually all of the aromatics have been removed.

In the experiments on the solubility of pure naphthenes, it was found that only a slight amount of this type hydrocarbon dissolved when less than 50 or 60% of sulphur dioxide was used. It will be recalled that their solubility increased rapidly as the amount of solvent reached 75 to 80%. It seemed probable, therefore, that aromatics which are completely miscible with sulphur dioxide, might be separated from the naphthenes if the percentages of solvent were kept low. The results given in Tables VIII and IX show this to be true. From a mixture containing only 10% benzene and 90% naphthenes it was possible to separate almost pure benzene, using equal volumes (50 per cent) of the solvent. The 15% bezene mixtures also show a fairly good separation. But as the benzene content of the starting mixture increases, the sulphur dioxide-benzene mixture seems to form a solvent for the naphthenes, so that with 50% aromatics present, the naphthenes are entirely miscible with 50% sulphur dioxide. This is analogous to the solubility of paraffins in aromatics-sulphur dioxide mixtures. The xylene-naphthene mixture (Table IX) show by comparison of the indices of refraction with the original oils, fairly satisfactory separations. In this case, as in the aromatic-paraffin separations, cleaner separations are possible with smaller amounts of xylene in the mixture. This is due to the solvent action of naphthenes of the xylene-sulphur dioxide complex, which is strengthened with increasing proportions of the aromatic. In no case in the naphthene-aromatic work was there noticed the peculiar retrograde solubility shown by the paraffin-aromatics.

C—Paraffin-Olefin Mixtures

Hexane-Hexylene, Table X.

Pentane-Amylene, Table XI.

Pure olefins are entirely miscible with sulphur dioxide, while paraffins are insoluble. Tables X and XI show that olefins may be separated rather closely from mixtures which are not richer in olefins than 25%. In mixtures richer than 25% the olefins and sulphur dioxide act as a solvent for the paraffins so that with 50%

B.—Aromatic-Naphthene Mixtures

Benzene-Cyclohexane, Table VIII.
Xylene-Naphthenes, Table IX.

Table VIII.—Separation of Aromatic-Naphthene Mixtures

(Aromatic) Benzene—Specific gravity 0.880, refractive index 1.5014.
(Naphthene) Cyclohexane, specific gravity 0.780, refractive index 1.4255.

Temp. °C.	Percent Benzene in Mixture	Cyclo-hexane in Mixture	Percent of Mixture Used	Percent SO_2 Added	Percent of oil Mixture Dissolved	Index of Dissolved Oil	Index of Undissolved Oil
—18	10	90	73.0	27.0	0.0	.....	.....
—18	10	90	60.0	40.0	5.0	1.4992	1.5258
—18	10	90	55.0	45.0	12.0	1.4965	1.4262
—18	10	90	50.0	50.0	22.5	1.4602	1.4261
—18	15	85	75.0	25.0	26.0	1.4616	1.4269
—18	15	85	67.0	33.0	28.0	1.4613	1.4271
—18	15	85	55.0	45.0	30.0	1.4608	1.4271
—18	15	85	50.0	50.0	32.5	1.4600	1.4276
—18	25	75	50.0	50.0	48.0	1.4608	1.4279
—18	25	75	25.0	75.0	62.0	1.4590	1.4274
—18	50	50	50.0	50.0	100.0	.....	.....
—18	50	50	45.0	55.0	100.0	.....	.....
—18	50	50	40.0	60.0	100.0	.....	.....

Table IX.—Separation of Aromatic-Naphthene Mixtures

Xylene—Refractive index, 1.4989.
Naphthene—Refractive index, 1.4345.

Temp. °C.	Percent Xylenes in Mixture	Percent Naph-thenes in Mixture	Percent of Mixture Used	Percent SO_2 Added	Percent Mixture Dissolved	Index of Dissolved Oil	Index of Undissolved Oil
—18	5	95	50.0	50.0	3.2	1.4961	1.4398
—18	10	90	50.0	50.0	8.0	1.4918	1.4410
—18	15	85	50.0	50.0	13.8	1.4893	1.4411
—18	20	80	50.0	50.0	20.0	1.4879	1.4403
—18	25	75	50.0	50.0	30.0	1.4845	1.4415
—18	50	50	50.0	50.0	72.5	1.4722	1.4592
—18	60	40	50.0	50.0	100.0	.....	.....

Table X.—Separation of Paraffin-Olefin Mixtures

(Paraffins)—Pentane and Hexane, refractive index 1.3629.
(Olefins)—Hexylene, refractive index 1.3994.

Temp. °C.	Percent Hexy-lene in Mixture	Percent Paraffins in Mixture	Percent of Mixture Used	Percent SO_2 Used	Percent of oil Mixture Dissolved	Index of Dissolved Oil	Index of Undissolved Oil
—18	5	95	50.0	50.0	1.3	1.3978	1.3678
—18	10	90	50.0	50.0	5.0	1.3935	1.3689
—18	15	85	50.0	50.0	6.5	1.3918	1.3789
—18	20	80	50.0	50.0	7.5	1.3905	1.3791
—18	25	75	50.0	50.0	20.0	1.3873	1.3803
—18	50	50	50.0	50.0	100.0	.....	.....

Table XI.—Separation of Paraffin-Olefin Mixtures

(Paraffin)—Pentane, index of refraction 1.3629.
(Olefin)—Amylene, index of refraction 1.3880.

Temp. °C.	Percent Amy-Paraffin in Mixture	Percent Pen-thene in Mixture	Percent of Mixture Used	Percent SO_2 Used	Percent of oil Mixture Dissolved	Index of Dissolved Oil	Index of Undissolved Oil
—18	5	95	50.0	50.0	2.7	1.3875	1.3634
—18	10	90	50.0	50.0	6.6	1.3868	1.3650
—18	15	85	50.0	50.0	10.5	1.3821	1.3676
—18	20	80	50.0	50.0	14.2	1.3792	1.3690
—18	25	75	50.0	50.0	20.5	1.3774	1.3705
—18	50	50	50.0	50.0	100.0	.....	.....

D—Paraffin-Naphthene Mixtures

Nonane-Cyclohexane—Table XII.
Gasolene-Naphthenes (75 deg.-155 deg.) Table XIII.
Gasolene-Naphthenes (175 deg.-200 deg.) Table XIV.
Paraffins (175 deg.-200 deg.) Naphthenes (175 deg.-200 deg.) Table XV.

E. (a) Olefin-Naphthene Mixtures, Table XVI.
(b) Olefin-Aromatic Mixtures, Table XVII.

Table XVI.—Separation of Olefin-Naphthene Mixtures

Octylene—Index of refraction 1.4145.
Naphthenes—Index of refraction, 1.4267.

Temp. °C.	Percent Olefin in Mixture	Percent Naph-thene in Mixture	Percent of Mixture Used	Percent SO_2 Added	Percent of oil Mixture Dissolved	Index of Dissolved Oil	Index of Undissolved Oil
—18	10	90	50.0	50.0	8.5	1.4147	1.4263
—18	20	80	50.0	50.0	17.0	1.4156	1.4259
—18	50	50	50.0	50.0	46.0	1.4162	1.4250

Table XVII.—Olefin-Aromatic Mixture

Benzene—Index of refraction 1.5014.
Hexylene—Index of refraction 1.3994.

Temp. °C.	Percent Olefin in Mixture	Percent Aromatic in Mixture	Percent Mixture Used	Percent SO_2 Added	Percent Oil Dissolved
—18	20	80	50	50	100
—18	50	50	50	50	100

(a) Olefin-Naphthene Mixtures. For this separation was used a mixture of octylene (index 1.4145) and naphthenes boiling between 75 deg. and 155 deg. (index 1.4267). The results are shown in Table XVI. Using a volume of solvent equal to the volume of oils, it was possible to make very close separations on mixtures containing as high as 50% olefins. The separation of practically pure olefins from naphthenes is possible with sulphur dioxide, providing that not higher than 50% of the solvent is used.

olefins we have homogeneous systems formed. For paraffins containing 20% olefins, however, the indices of refraction show very good separations. The refining of gasolenes and kerosenes to free from unsaturated hydrocarbons is readily accomplished by liquid sulphur dioxide since in natural petroleums the percentage of olefins rarely is over 10 or 15% and usually not so high.

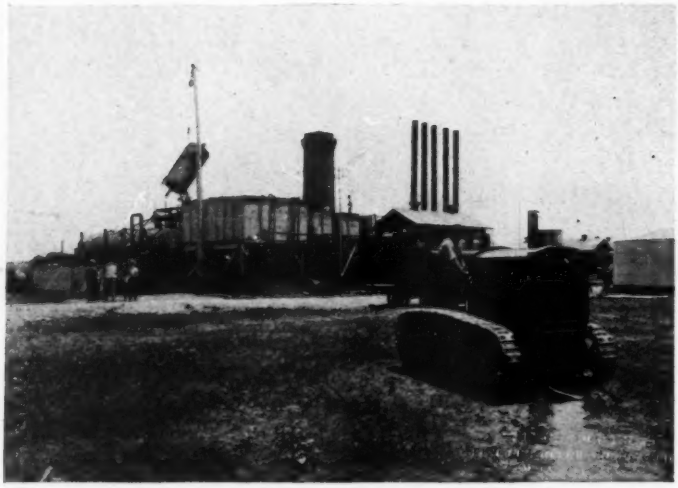
Although the literature on sulphur dioxide refining of oils states that naphthenic hydrocarbons are as insoluble in sulphur dioxide as the paraffins and remain undissolved with them after the aromatics and unsaturateds are removed, the present work on individual naphthenes indicates that these hydrocarbons may be entirely dissolved, providing sufficient solvent is added. This solubility curve takes a sharp rise when about 85% of the solvent is added, indicating the formation of a chemical complex. The crystals formed at about this concentration offer further evidence in support of this assumption.

Since this difference in solubility exists, the separation of naphthenes from paraffins was investigated, with a satisfactory degree of success as shown in Tables XII, XIII, XIV and XV.

Comparing, in these tables, the index of the dissolved and undissolved portions with indices of the original oils, we find in every experiment considerable separation and in certain cases very close separation. It will be noticed that when only an equal quantity of solvent was added no separation occurred, but that the solubility of the naphthenes was marked when over 80% solvent was used. Thus, in Table XII, when to a mixture of 15% cyclohexane in 85% paraffins, 86.7% sulphur dioxide was added, a separation of 15 per cent of oil took place. The index of this soluble portion was 1.4205 compared with 1.4255 for the pure cyclohexane, a very satisfactory separation. The other tables show equally good separations for mixtures containing up to 25% naphthenes. Above this percentage separations are not as clean cut, the paraffins tending to dissolve in the naphthene-sulphur dioxide system.

Table XIII gives the results of a run on 150 cc. of mixture containing 15% of naphthenes boiling from 175 deg. to 200 deg. and 85% of paraffins of the same boiling point. In one treatment using twice the volume of solvent as of oil, 13% of the oil dissolved. The index of this portion showed almost pure naphthenes.

Heretofore there has been no method of separating naphthenic from paraffin hydrocarbons. The determination of such a mixture in the past involved fractionation to one or two degrees and analysis of the carbon and hydrogen content. Liquid sulphur dioxide, therefore, may prove a valuable aid in such a determination, particularly as the naphthenes are recovered and may be used for further physical and chemical tests. Moreover, since naphthenes have been regarded as the best lubricants of all hydrocarbons, the separation of these, almost pure, may prove of commercial value in the refining of such oils.



Due to the inability to get mule power in unison the Clayton Refining Company, west of Dallas, Texas, in elevating towers to position by gin pole with double and single block put a Caterpillar tractor to work. The "Caterpillar" did the work inch at a time and put as many as six towers in place in eight hours.

Table XII.—Separation of Paraffin-Naphthene Mixtures

(Paraffins)—Nonane, decane; specific gravity 0.730, index of refraction 1.4174.

(Naphthene)—Cyclohexane, specific gravity 0.780, index of refraction 1.4255.

Temp. °C.	Percent Paraffin in Mixture	Percent Naphthene in Mixture	Percent of Mixture Used	Percent SO_2 Added	Percent of oil Mixture Dissolved	Index of Dissolved Oil	Index of Undissolved Oil
—18	85	15	50.0	50.0	0.0	.....	.....
—18	85	15	31.2	68.8	0.0	.....	.....
—18	85	15	24.4	75.6	0.0	.....	.....
—18	85	15	19.2	80.8	0.0	.....	.....
—18	85	15	18.2	81.8	2.0	1.4250	1.4189
—18	85	15	15.4	84.6	7.0	1.4247	1.4183
—18	85	15	13.3	86.7	15.0	1.4244	1.4185
—18	85	15	10.0	90.0	15.0	1.4237	1.4187

Table XIII.—Separation of Paraffin-Naphthene Mixtures

Gasolene—Specific gravity 0.721, index of refraction 1.4008.

Naphthene (75-155°)—Specific gravity 0.784, index of refraction 1.4267.

Temp. °C.	Percent Paraffins in Mixture	Percent Naphthenes in Mixture	Percent of Mixture Used	Percent SO_2 Added	Percent of oil Mixture Dissolved	Index of Dissolved Oil	Index of Undissolved Oil
—18	95	5	50.0	50.0	0.0	.....	.....
—18	90	10	50.0	50.0	0.0	.....	.....
—18	85	15	50.0	50.0	0.0	.....	.....
—18	80	20	50.0	50.0	0.0	.....	.....
—18	75	25	50.0	50.0	0.0	.....	.....
—18	50	50	50.0	50.0	0.0	.....	.....
—18	75	25	47.5	52.5	0.0	.....	.....
—18	75	25	38.0	62.0	2.5	1.4258	1.4012
—18	75	25	34.8	65.2	3.5	1.4251	1.4029
—18	75	25	27.6	72.4	12.5	1.4215	1.4038
—18	75	25	20.5	79.5	23.0	1.4189	1.4041
—18	75	25	17.8	82.2	25.0	1.4172	1.4058

Table XIV.—Separation of Paraffin-Naphthene Mixture

Gasolene—Index of refraction 1.4187.

Naphthenes—Index of refraction 1.4460.

Temp. °C.	Percent Naphthenes in Mixture	Percent Paraffins in Mixture	Percent of Mixture Used	Percent SO_2 Added	Percent of oil Mixture Dissolved	Index of Dissolved Oil	Index of Undissolved Oil
—18	5	95	15.0	85.0	2.5	1.4455	1.4188
—18	10	90	15.0	85.0	6.6	1.4442	1.4192
—18	15	85	15.0	85.0	10.0	1.4415	1.4199
—18	20	80	15.0	85.0	13.4	1.4395	1.4211
—18	25	75	15.0	85.0	19.2	1.4386	1.4222
—18	50	50	6.0	94.0	35.0	1.4322	1.4329

Table XV.—Paraffins-Naphthenes Mixtures

Paraffins, B. P. 175°-200° C. Sp. Gr. 0.781, index refraction 1.4277.

Naphthenes B. P. 175°-200° C. Sp. Gr. 0.824, index refraction 1.4460.

Temp. °C.	Percent Paraffins in Mixture	Percent Naphthenes in Mixture	Percent SO_2 Used Twice Volume of oil	Percent Dissolved Oil	Index	Undissolved Index
—15	85	15		13	1.4450	1.4282

Breaking Down Oil Field Emulsions

Bartlesville, Oklahoma.—At the experiment station here, D. B. Dow, chemical engineer of the Bureau of Mines, assisted by C. E. Reistle, junior chemist, is conducting an investigation to determine satisfactory methods for breaking down oil field emulsions. In several Mid-Continent fields, oil as it comes from the wells contains relatively high percentages of water emulsified with the oil (commonly known as B. S.) and in many cases this emulsion is run into sumps and burned. In some fields large quantities of B. S. are stored in tanks, because no economical method for treating them have been developed. In this investigation it is planned to study the methods that are now in use, such as steaming, chemical treatment, electrical process, and centrifugal separation, as a means of determining the method that is best suited for each particular type of emulsion. A series of laboratory tests will be made in order to determine the effect of such factors as the viscosity of the oil, the relative percentages of oil and water, the effect of different salts dissolved in the water, and the presence of other emulsifying agents, such as finely divided silt. The effort will be made to develop a method of treating emulsion that will be economical for use on properties that produce only a few barrels of oil daily, where the installation of expensive equipment would not be justified.

White Eagle Opens Up London Export Office

KANSAS CITY, MO.—A London office to handle the company's export business is being satisfactorily arranged by the White Eagle Oil and Refining Company with headquarters in this city, according to an announcement given out by L. L. Marcell, president. The White Eagle is planning to carry on an extensive export business and now is lining up connections in England and continental Europe to ...is end. Export terminals already have been acquired at Marrero, opposite the city of New Orleans, on the Mississippi in Louisiana. Improvements are being made to increase the facilities for handling cargoes and for assembling refined oils at tidewater.

The retail distributing end of the White Eagle Oil and Refining Company's oil business is growing steadily and further expansion has been necessitated. For a consideration not made public the White Eagle has taken over thirty filling stations of the Lesh Oil Products Company in Kansas and Iowa. Twenty-five of the stations are located in towns in Kansas and five in Iowa. This purchase gives the White Eagle 242 distributing station units scattered over Kansas, Missouri, Nebraska, Iowa and one or two other states.

The expansion program now being carried out by White Eagle is placing the company in the forefront in its marketing area. It is known that the company has still another deal or two under consideration at this time.

Factors in Locating Carbon Black Plants

Local conditions should be considered when constructing new plants

Much information should be secured on the subject before construction is started on a carbon black plant, the subjects of greatest importance being the distance of the plant from railways or navigable streams, state laws, the depths of the wells, thickness of the gas bearing strata, gas pressure, gasoline content, whether the gas is casing-head or dry gas, amount of proved territory, history of the field, location of the field in regard to possible large gas consumers, distance from trunk pipe lines for the transportation of natural gas, open flow capacity of wells on prospective gas leases, and the richness of the gas in carbon black yield per 1000 cubic feet.

The yield of carbon black recovered follows very closely the percentage of ethane, heating value, and the amount of elementary carbon calculated from the hydrocarbons determined by analysis.

The average yield is at present about one pound of black from 1000 cubic feet of gas, and as 1000 cubic feet of natural gas contains from 35 to 40 pounds of carbon the recovery is quite low.

It is not considered to build a plant having a capacity of less than 2,000,000 cubic feet of gas per day, producing 2000 to 3000 pounds of carbon black. The average cost of such a plant would be about $60,000.

Roy O. Neal, Chemical Engineer, Bureau of Mines, states that "the gas from Louisiana has the lowest percentage of nitrogen and the highest percentage of hydrocarbons, namely 97.56, yet, when burned at a factory, gives the smallest yield of carbon black."

This is due to the large proportion of methane that contains 33.5 pounds of carbon per 1000 cubic feet, whereas the same quantity of ethane contains 67 pounds of carbon. The two gases from West Virginia have very similar compositions and give approximately the same yields of carbon black. The gas supplied to the plant in Wyoming has the largest calorific value and carbon content, and considerably more ethane than any of the other gases, and gives the greatest yield of carbon black.

With the richer gases, not only the actual quantity of carbon is larger, but the percentage recovery also increases.

In the testing apparatus as in the commercial the practice is to burn the gas without air under a series of sheet iron shields which collect the carbon from the yellow flame.

The gas is passed through a meter and so measured, and the collected black is scraped off the shields and weighed.

The old style lava tip burner is used, and in a commercial plant, many thousands of these tips are used.

Carbon Content and Quantity of Carbon Black Recovered by the Channel Process*

	Louisiana per cent	West Virginia per cent	West Virginia per cent	Wyoming per cent
Methane	94.12	70.75	65.23	46.45
Ethane	3.44	24.14	30.07	43.10
Carbon dioxide	0.50	0.28	1.56	0.96
Nitrogen	1.94	4.83	3.14	9.49
Heating value	962	1086	1134	1176
Pounds of carbon per 1000 cu. ft. of gas	33.8	39.9	42.3	44.3
Reported obtained as carbon black, lb. per 1000	0.80	1.00	1.10	1.40
Percent recovery	2.4	2.5	2.6	3.1

*Table from chemical analyses of gases by D. B. Dow, Bureau of Mines.

Factors Affecting Carbon Black Plants

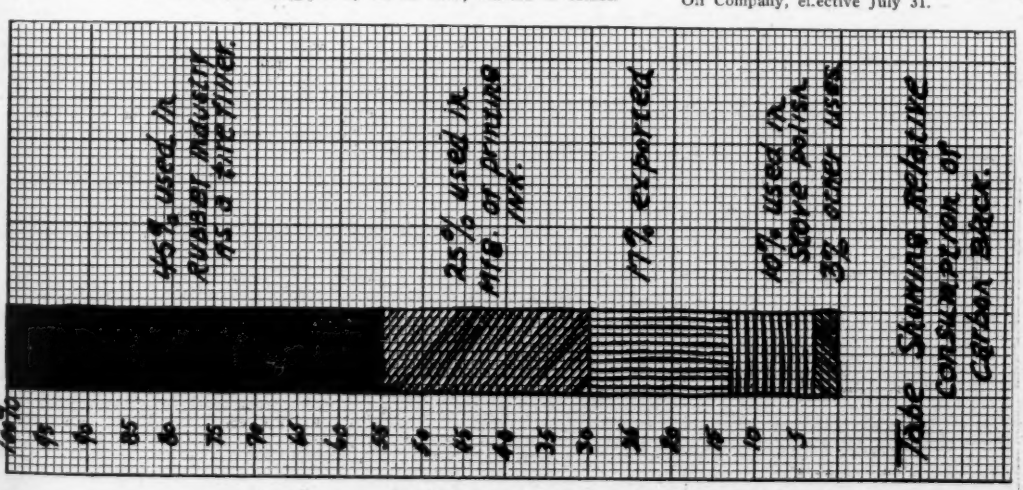
Washington, Aug. 10.—In contemplating the construction of a carbon black plant, definite information should be obtained on several subjects, states the U. S. Bureau of Mines in Bulletin 192 just issued. Matters that should be given consideration are the distance from a railroad or a navigable stream; state laws; the depth of wells; the thickness of gas-bearing strata; gas pressure; gasoline content; and whether the gas is casing-head or dry gas; amount of proved territory; history of field; drilling practice; location of field in regard to possible large gas consuming centers; distance from trunk pipe lines for the transportation of natural gas; open flow capacity of wells on prospective gas leases; and tests on the richness of gas to ascertain the approximate quantity of carbon black procurable per thousand cubic feet.

MAGNOLIA ADDS 20 NEW PRESSURE STILLS AT BEAUMONT

Beaumont, Texas, Aug. 15.—Twenty new pressure stills of the Burton type are being erected at the Beaumont refinery of the Magnolia Petroleum Company.

This addition makes a total of 120 stills of that type at the Beaumont plant.

Kansas City, Mo.—M. C. Lysle has resigned as traffic manager of the Mutual Oil Company, effective July 31.


45% used in rubber industry as a softener.
25% used in mfg. of printing ink.
11% exported.
10% used in stove polish.
3% other uses.
Total Showing Relative Consumption of Carbon Black.
1909

Petroleum Chemists Now Have Organization

Division of American Chemical Society made permanent, self-governing body

PITTSBURGH, PA., Sept. 7.—The formation of the petroleum section of the American Chemical Society into a permenent and self-governing division was the outstanding development at the fall meeting of the society held here during the past week. The body was founded about a year and a half ago as an experiment but the vast field of research offered by this industry has justified the organization of a separate division.

With the organization of the petroleum section an extensive research program has been launched and many scientific problems which have for some time caused much worry to producers and refiners will be immediately taken under consideration. The new division will also offer for the first time a central point for the assembling and distribution of information throughout the industry.

Officers of the new petroleum division are: Dr. T. G. Delbridge, Atlantic Refining Company, chairman; R. R. Matthews, Roxana Petroleum Corporation, vice chairman; W. A. Gruse, Mellon Institute, secretary. An executive committee composed of W. F. Faragher, Mellon Institute and E. W. Dean, Standard Oil Company, New Jersey, was also appointed.

The purpose of the new organization as shown by its constitution is to develop the science of chemistry as applied to the oil industry but not to interfere or duplicate the work of any other organization. Membership into the division can be obtained by any chemist interested in the petroleum business for the annual dues amounting to $2 or $3 a year.

The committee appointed at the Birmingham meeting to consider a list of 80 problems for research offered by Dr. Manning, made its report through Chairman Faragher at the close of the meeting. Those subjects selected for immediate solution were as follows:

Increased use of fractionating columns in refining.

Rational specifications for production—especially as to volatility of motor fuels and oiliness of lubricating oils.

Actual need of highly refined gasoline—effect on motors or partial refining—education of the public to use gasoline having a little color and some bad odor.

Fundamental causes of carbon formation—effect of adding reagents to motor fuel.

Colloidal study of lubrication.

Hydrocarbon chemistry.

Chemistry of S, N and O compounds.

Chemistry of sulphuric acid refining.

Color changes in petroleum products.

This committee was composed of Dr. Faragher, R. E. Wilson, Massachusetts Institute of Technology, C. E. Walters, Bureau of Standards, R. P. Anderson, United Gas Company, E. W. Dean. Standard Oil Company, New Jersey, R. R. Matthews, Roxana Petroleum Corporation and N. A. C. Smith, Bureau of Mines. .

After the outlining of a research program by Dr. Van H. Manning, Dr. Delbridge proposed a resolution of putting the petroleum division strongly behind the program and it was unanimously adopted. A committee for furthering the plan was also pledged by the executive committee.

A prize similar to that of the Noble prize offered in Europe each year has been offered by the Allied Chemical and Dye Corporation of New York to be awarded annually to the chemists who make the most valuable contributions to the science during the year. The prize offered is $25,000.

Papers read at the gathering follow:

Further data on the measurement of the effective volatility of motor fuels, by Robert E. Wilson and Daniel P. Bar, Mass. Inst. Technology.

Effect of certain physical and chemical properties of emulsifying agents on the stability of oil-water emulsions, by Leon W. Parsons and Brian Mead, Mass. Inst. Technology.

Engine experiment with high sulphur fuels, by Carl O. Johns, Standard Oil Company, New Jersey.

Gasoline saved on government trucks due to adjusting the carburetors by gas analysis, by G. W. Jones and A. C. Fieldner, Bureau of Mines, Pittsburgh.

Some factors affecting the accuracy of Saybolt viscosity measurement and their control, by P. E. Klopsteg and W. H. Stannard, Chicago.

Cracking of unsaturated hydrocarbons by heat to give saturated hydrocarbons, by Ralph H. McKee and Ralph T. Goodwin, Department of Chemical Engineering, Columbia University.

The refining of gasoline and kerosene by hypochlorite solutions, by A. E. Dunstan and B. T. Brooks, Anglo-Persian Oil Company and Mathieson Alkali Works.

Refining of cracked hydrocarbon oils, by Jacque C. Morrell and Gustav Egloff.

Practical distillation of various petroleums under reduced pressure with new type receiver, by Jacque C. Morrell and Gustav Egloff.

Sulfo-acid bodies in lubricating oils, by G. L. Oliensis, Barber Asphalt Company.

Lubricant and asphaltic hydrocarbons in petroleum, by C. F. Mabery, Case School of Applied Science, Cleveland.

Low speed-high pressure friction tests with a Kingsbury machine, by W. F. Faragher and Ronald Reamer, Mellon Institute, Pittsburgh.

The mechanism of partial lubrication, a review by R. E. Wilson.

Viscosity temperature ounces or fractions of typical American crude oils, second paper, by F. W. Lane and E. W. Dean, Bureau of Mines.

Origin, migration and accumulation of oil and gas, by R. E. Somers, University of Pittsburgh.

The probable mother substance of petroleum, by Reinhardt Thiessen, Bureau of Mines, Pittsburgh.

Mirando Crude Has Large Lube Content

Laredo, Texas.—Mirando City crude yields a large percentage of heavy lube oil of pale color. The crude, which is of amber color, is 21.6 gravity, 165 open cup flash and 220 fire test.

The crude yields 57 per cent 28.0 gravity gas oil, 10 per cent 200 vis. pale lube oil, 22 per cent 1500 vis. pale lube oil, 3 per cent loss and 8 per cent bottoms, which goes into the fuel. In the case of this particular bottom, distillation could have been carried on longer, and about 3 or 4 per cent more run into the heavy lube oil cut, as the color of the 8 per cent bottom was a good green.

Determining Amount of Sediment in Fuel Oil

Washington, D. C., Sept. 28.—A. D. Bauer, laboratory assistant of the Bureau of Mines at Pittsburgh, Pa., has made comparative studies of the laboratory methods of determining the amounts of sediments in fuel oil in the Bureau's laboratories. Comparisons were made between the methods developed in the Washington and Pittsburgh laboratories, and these methods were also compared with the ordinary centrifuge method. Mr. Bauer is comparing several types of stills in order to make a still that, on a larger scale, will duplicate the work of the small analytical stills in the Bureau of Mines laboratories.

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PERSONNEL OF THE INDUSTRY

W. M. WELSH,
President of the Association of Natural Gasoline Manufacturers and General Manager of the Tidal Oil Company.

C. A. Braley, with the Sinclair Refining Company at Kansas City, has returned to his home after a serious operation at Mayo's hospital at Rochester, Minnesota. Mr. Braley is expected to be able to return to his work within the next few weeks.

D. W. Moffit, vice president of Cosden and Company, with headquarters in Tulsa, was in New York last month in conference with J. S. Cosden, president of the company.

C. P. Bowie, petroleum engineer of the Bureau of Mines, assisted by J. S. Desmond, chemical laboratorian, is continuing at the San Francisco office of the bureau the development of the Bowie-Gavin cracking process for the refining of heavy crudes, tarry substances and residuals that are difficult to treat by other methods.

H. B. Moore, with the Sinclair Refining Company at Chicago, has been transferred to South Bend, Indiana, where he will be manager of the Sinclair's branch there.

W. D. Richardson, president of the recently organized Richardson Refining Company, was in Tulsa late in the month on a brief business trip.

J. S. Cosden, president of Cosden and Company, in company with Mrs. Cosden, has sailed for Europe to recuperate from his recent illness.

C. L. Mayhall, with the Imperial Refining Company at Tulsa, was confined to his home for several days during the month with a severe cold.

P. H. Hertzog, manager of the Fort Worth offices of the Nortex Refining Company, made a brief business trip up to Wichita Falls during the month.

P. M. Miskell, president of the Empire Refineries, Inc., with headquarters at Tulsa, Oklahoma, is now in Los Angeles for a brief pleasure trip. Mr. Miskell is accompanied by his wife and expects to visit several California points before returning to his offices.

E. E. Schock, president of the Indiahoma Refining Company with headquarters in St. Louis, made an inspection trip to his Okmulgee plant during the month and also visited Tulsa.

H. M. Evans, director of the Lion Oil and Refining Company, has returned home from a two months' trip to European countries. He visited France, Italy and several other countries while away.

Elliott Jones, president, and W. B. Pate, sales manager of Elliott Jones and Company, Inc., which operates a refinery at San Antonio, Texas, were in Wichita Falls late in the month mingling with old friends.

James Lawrence, formerly attorney for the Meridian Petroleum Corporation, has been appointed commerce counsel for the Western Petroleum Refiners' Association. Mr. Lawrence succeeds H. H. Birmingham, resigned.

William D. McCurdy, former department manager at the Sun Company's Marcus Hook refinery, has been appointed district representative of the Peninsular State Oil Company at Orlando, Florida. The Peninsular State is the Florida distributing subsidiary of the Sun Company.

Dan Corcoran, sales manager of the Cameron Refining Company at Ardmore, Oklahoma, left late in the month for a three weeks' vacation enjoyed by a motor trip. Mr. Corcoran was accompanied by his family.

Earl W. Husted, president of the American Refining Company of Great Falls, Montana, made a trip through Wyoming during the month closing up contracts for a crude supply for his plant, which is to begin operations early in October.

L. L. Long, formerly of the Carson Petroleum Company, has become connected with the Johnson Oil and Refining Company and will represent the company in the New England states. Mr. Long at one time was secretary of the Beaver Refining Company.

Frank Turnbull, Mid-Continent representative of the Great Western Smelting and Refining Company, made a general inspection trip throughout his territory during the month. The Great Western has headquarters at St. Louis.

L. L. Marcell, president of the White Eagle Oil and Refining Company, of Kansas City, was in Wyoming during the month in company with Lee Scott, vice president. It is understood that the trip was made for the purpose of contracting for a quantity of Salt Creek crude.

Dr. R. E. Wilson, formerly head of the department of research and applied chemistry at the Massachusetts Institute of Technology, has accepted a position with the Standard Oil Company of Indiana as director of a research program for that company.

H. B. Bernard, general superintendent of the Sinclair Oil and Gas Company, with headquarters at Tulsa, made an extended business trip during the month throughout the eastern states.

E. R. Perry, with Cosden and Company of Tulsa, was a visitor in Chicago during the past month in company with Sam Collins of the Marland Refining Company of Ponca City.

RECENT REFINERY PATENTS ISSUED

WASHINGTON, D. C.—The following patents have been issued during the last month by the United States Patent Office:

Low Boiling-Point Hydrocarbons.

No. 1,426,813, issued on August 22 to John C. Black, Beverly Hills, Calif., a process for the production of low boiling-point hydrocarbons. In the process for the production of low boiling point hydrocarbons, the combinations of steps consisting in heating the hydrocarbons in a single passage to a temperature sufficient to crack them and under pressure of not less than 35 atmospheres to prevent vaporization thereof, then reducing their rate of flow, and then reducing the pressure and vaporizing the hydrocarbons separating fractions heavier than gasoline and returning said fractions to the cracking apparatus.

In the process for the production of low boiling point hydrocarbons, the combination of steps comprising heating the hydrocarbons in a coil to a temperature sufficient to crack them and under pressure of not less than 35 atmospheres to prevent vaporization thereof, transferring the hydrocarbons to a tube or chamber of larger cross sectional area completely filling the larger tube or chamber while maintaining them under pressure to deposit the carbonaceous matter and finally discharging the undeposited hydrocarbons from the chamber.

Vertical Retorts.

No. 1,427,426, a patent on heating or vertical retorts for the distillation of carbonaceous materials, issued on August 29 to William Wild, assignor of one-half to West's Gas Improvement Company, Limited, Manchester, England. In means for the distillation of carbonaceous materials, in combination, a row of vertical retorts, superposed horizontal combustion chambers disposed around the said retorts for heating the latter, each row of retorts being heated in any one horizontal plane by two chambers arranged at its opposite sides, gas inlets to said chambers at one end of the row of retorts, air supply conduits extending along the whole horizontal length of the combustion chambers to adjacent said gas inlets, further air supply conduits extending along a portion only of the horizontal length of the combustion chambers and each entering one of the latter at a point between its ends, and a waste gas outlet from each combustion chamber at the end thereof opposite to the gas inlet, as set forth.

Catalyzing Oils.

No. 1,427,626, a process and apparatus for catalyzing oils and revivifying the catalyst, issued on August 29 to Ernest V. Owen, assignor to The Hoover Company Chicago, Ill. The method of treating oil to produce low boiling hydrocarbon which consists in flowing the oil to be treated together with aluminum cloride hydrocarbon catalyst, through a catalyzing chamber, separating the oil from the catalyst and returning it to the catalyzing chamber alongside a wall thereof, and applying heat to the returning body of oil, on a side thereof being maintained at a temperature favorable to catalyzation, and vapors being removed.

Oil-Topping Plant.

No. 1,428,159, a patent for an oil-topping plant, issued on September 5 to Benjamin Gallsworthy, Port Arthur, Texas. A device of the character described, including a receptacle, a furnace arranged adjacent thereto, an outlet manifold, flue pipes connected at one end directly into said furnace and arranged in vertical coils, in said receptacle and their other ends terminating in said manifold, oil inlet pipes arranged above the respective coils and whose undersides are provided with perforations through which crude oil may be discharged onto the respective coils, downwardly converging baffles arranged on opposite sides of each of the respective turns of the coils and having their lower edges spaced apart throughout their length, and provided to direct the oil passing over each turn down onto the turn underneath, and an outlet leading from the receptacle above the lower coils.

Treating Natural Emulsions.

No. 1,428,204, issued on September 5 to William S. Barnickel, St. Louis, Mo. An apparatus for treating natural emulsions of petroleum comprising a supply tank, a settling tank, a conduit leading from said supply tank, to said settling tank, a steam pump for drawing an oil mixture out of said supply tank and forcing it through said conduit, a treating solution tank, a proportional pump operated by said steam pump for drawing the treating solution from said tank and introducing it into the oil mixture before said mixture passes through the steam pump, means for agitating the treated mixture while it is flowing through said conduit, a steam pipe in said conduit for heating the treated mixture, and means for conducting the water of condensation from said steam pipe to a treating solution tank.

Conversion of Oils.

No. 1,428,311, an oil converting process for the conversion and transformation of oils, issued on September 5 to Joseph H. Adams, Flatbush, N. Y., assignor to the Texas Company, Houston, Texas. A process of producing lower boiling hydrocarbons from higher boiling hydrocarbons that comprises spraying a mixture of hot oil and steam into a chamber, the steam being superheated to a temperature sufficient to crack the oil by its direct action as it is commingled therewith, separating out and collecting the heavy residue in the lower portion of the chamber, withdrawing the collected residue, and taking off and condensing the evolved vapors from the upper portion of the chamber.

Oil Converting Apparatus.

No. 1,428,312, issued to Joseph H. Adams, assigned to The Texas Company, Houston, Texas. An oil converting apparatus comprising an expansion chamber having spaced chambers with a communicating passage, means for imparting heat to the communicating passage, a nozzle adapted to discharge into one of the chambers, an oil heating coil and a steam superheating coil connected to the nozzle, means for heating the coils so that the oil is vaporized and largely cracked by the direct action of the superheated steam as it is discharged from the nozzle into one of said chambers, a condenser in open communication with the expansion chamber and means for maintaining super-atmospheric pressure through the expansion chamber and condenser.

Cracking Hydrocarbons.

No. 1,428,338. An apparatus for cracking hydrocarbon oils, issued on September 5, to Frederick T. Manley, assignor to the Texas Company, New York, N. Y. An apparatus for cracking hydrocarbon oils comprising a cracking still maintained under pressure, means for heating the still intermediate its ends to a cracking temperature a pipe for supplying a stream of charging oil under pressure into the lower end of the still means for receiving the evolved vapors and separating out the heavier constituents thereof a return pipe directly connecting the separating means and said supply pipe for returning the condensate to the bottom of the still, and means for positively forcing the condensate into the charging oil traversing said supply pipe.

Continuous Cracking.

No. 1,428,339. Issued on September 5 to Frederick T. Manley, assignor to the Texas Company, New York, N. Y. The continuous process of cracking hydrocarbon oils of comparatively low boiling points which consists in bringing said oils in contact with a horizontally elongated body of higher boiling point hydrocarbon oil maintained at a temperature sufficient to cause vaporization and decomposition of said lower boiling oil, causing the vapors generated to pass along in contact with the elongated surface of said heated higher boiling point oil and preventing overheating of said vapors during said passage to maintain a substantially uniform temperature of sufficient intensity to continue the cracking of the vapors.

Distillation of Hydrocarbons.

No. 1,428,458, issued on September 5 to Carey W. Thompson, New York, N. Y. A process for distillation of hydrocarbons from oil shale comprising heating the shale by external means to free gasoline and light oils, removing light oils and gasoline then heating the shale at a higher temperature to vaporize the heavy hydrocarbons, and introducing the heavy vapors freed from said light oils and gasoline into a fresh cold quantity of shale prior to the first heat treatment.

Separating Oils.

No. 1,428,590, an apparatus for separating oils, issued to Adolph W. Hille, assignor to American Shale Reduction Company, a Corporation of Delaware. A centrifugal separator comprising an outer hollow member and an inner hollow member within and carried by the outer member and of substantially less diameter and open at its lower end, the inner and outer members being provided with discharge openings near their upper ends, means for rotating the two members together, and means for directing the liquid to be treated against the inner surface of the inner member near its lower end.

Converting Petroleum.

No. 1,430,977, issued on October 3 to Stephen L. Gartlan, Toronto, Ontario, Canada. A process for converting petro-

sene d stillate, which consists of subjecting the oil to successive heats increasing in temperature as the boiling point of the residual oil rises, permitting the oil vapors given off at each heat to expand under sub-atmospheric pressure, removing these vapors before the temperature is raised for the next successive heat, and continuing this procedure until a cracking temperature is reached, then injecting steam into the oil vapors, compressing the oil vapors given off at the successive heats into liquefied products and collecting and combining all the products in a common receptacle while still under pressure.

Distilling Fuel Oil

No. 1,423,134, issued on July 18 to Arthur Cumming Michie, Newcastle-on-Tyne, and Edmund George Weeks, Northumberland, England, assignors to Charles Hesterman Merz and William McClellan, both of Westminster, London, England. A method of continuously distilling fuel which consists in passing a heating medium through a body of said fuel, providing fresh charges of fuel separate from the said body of fuel, passing a heating medium through the charges and raising the temperature thereof above the temperature of condensation of the distillate but below a temperature that will effect appreciable decomposition of the fuel, and delivering the said charges while so heated to the body of the fuel.

Treating Oils Under Pressure

No. 1,423,500, issued July 18 to Roy Cross, Kansas City, Mo., assignor to Gasoline Products Company, Inc., New York, N. Y., covering a process of treating petroleum oil. The patent covers a continuous process of treating oils under pressure without substantial distillation, consisting in passing the oil In a relatively small stream through a heating zone where the oil is heated to a cracking temperature, in discharging the oil from the heating zone in a substantially liquid phase and at a cracking temperature to an enlarged insulating reacting chamber located outside of the heating zone where further cracking takes place, maintaining the oil in both the enlarged insulating reacting chamber and the heating zone under pressure of evolved gasses of the oil having a critical temperature below the cracking temperature of the bulk of the oil, said pressure being always sufficient to prevent any substantial vaporization of the oil, and in continuously removing the bulk of the oil in liquid phase and said pressure gases from said reacting chamber.

Cracking Hydrocarbons

No. 1,423,709, issued July 25 to John Collins Clancy, Niagara Falls, N. Y., assignor to the Nitrogen Corporation of Providence. The patent covers a process of cracking hydrocarbons, which comprises subjecting a hydrocarbon oil, while in vaporous condition, to the catalytic action of mercury vapor.

No. 1,423,710, issued July 25 to John Collins Clancy, Niagara Falls, N. Y., assignor to the Nitrogen Corporation Providence, for a process of desulpherizing oil. The patent covers a process of purifying mineral oil, which comprises, treating a mass of said oil with liquid anhydrous ammonia to cause the sulphur present in said oil to combine with said ammonia to form an ammonia-sulphur compound and separating said compound from the oil.

In a process of purifying mineral oil to step which comprises reacting upon said oil with ammonia in the presence of a catalyst to cause the sulphur present in the oil to combine with the ammonia.

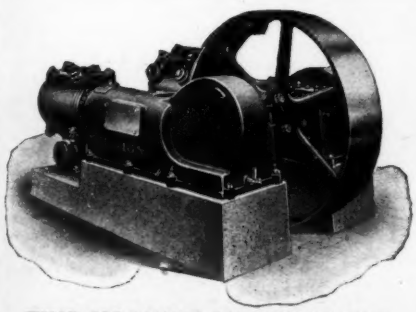
Recovering Sulphur

No. 1,423,711, issued July 25 to John Collins Clancy, assignor to the Nitrogen Corporation of Providence, for obtaining sulphur compounds from mineral oils and the like. The patent covers a process for recovering sulphur from sulphur-bearing mineral oil, which comprises effecting the removal of sulphur from said oil in the form of an ammonia-sulphur compound through the intermediacy of liquid ammonia.

Desulphurizing Crude Oil

No. 1,423,712, issued July 25 to John Collins Clancy, assignor to the Nitrogen Corporation, Providence, for a method of desulphurizing oil. The patent covers a process of desulphurizing mineral oil, which comprises treating a heated mass of said oil with ammonia vapor and steam.

No. 1,423,716, issued July 25 to Edward E. Hedges, New York, N. Y., for a process of distilling shale. The patent covers a process of distilling oil bearing shale, consisting in introducing raw shale into one end of an elongated retort, moving the



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shale along the retort under constant agitation, maintaining heat within said retort varying from a temperature to drive off the most volatile ingredients at the end of the introduction to a temperature to decompose water in the presence of carbon at the opposite end, conducting the released gases backwardly through progressively cooler areas, introducing steam into contact with the heated fixing carbon residuum at the hotter end, commingling the gases released by decomposition with the released volatile gases, and discharging the spent shale residuum from said hotter end.

Gasoline Purifier

No. 1,423,970, issued on July 25 to William J. Sedelbauer, Toledo, Ohio, covering a gasoline purifier. The patent covers a purifier with a tank having an inverted conical bottom portion, the cone forming the bottom having considerable altitude relative to its base, a pipe extending downward along the cone surface of the bottom portion of the tank to near the apex of the cone of the bottom of the tank, and having openings extending at an angle to the vertical plane passing through the axis of the cone at the bottom of the tank and the axis of the pipe, the cone member having its apex located above its base and the property of its base located near the base of the cone of the bottom portion of the tank and in spaced relation with respect to the cone of the bottom of the tank, the cone member having a plurality of openings, means for inserting a cleaning agent into the bottom portion of the tank, means for directing the material to be purified to the said pipe having the said openings, and means for drawing off the liquid at different levels.

Converting Oil

No. 1,424,574, issued August 1, to Almer M. McAfee, assignor to Gulf Refining Company, Pittsburgh, for a process of converting oil. The patent issued covers the following:

The process of converting higher boiling petroleum oils into lower boiling oil which comprises heating such a higher boiling oil together with anhydrous aluminum chlorid to boiling temperature, separating vapors of lower boiling oil formed from higher boiling oil, and condensing the vapors of the lower boiling oil.

The process of converting higher boiling petroleum oils into lower boiling oil which comprises heating such a higher boiling oil together with anhydrous aluminum chlorid to distillation temperature, separating vapors of lower boiling oil formed from higher boiling oil, condensing vapors of lower boiling oil formed, and returning the higher boiling oil to the body of oil undergoing distillation.

In the treatment of petroleum oils, the process which comprises continuously distilling off low boiling vapors from a boiling body of high boiling oil containing aluminum chlorid and continuously supplying additional high boiling oil to said body.

The process of converting petroleum hydrocarbons having higher boiling points into naphtha, which consists in heating a mixture of said hydrocarbons and anhydrous aluminum chlorid to a temperature producing vapor of a lower boiling oil having an end-boiling point not substantially above the end boiling point of naphtha and maintaining the mixture at such temperature.

Oil Topping Still

No. 1,424,998, issued on August 8 to James T. Fenton, Salt Lake City, covering a process of and apparatus for distilling. The patent covers an apparatus adapted for use as an oil topping still, having a stepped bottom, an oil inlet, an overflow weir adjacent said inlet, and a vertically movable gate over said weir, each end of said gate being vertically adjustable.

An oil still comprising a distilling chamber, an oil inlet pipe at one end of said chahber and an oil well at the other end thereof, two valves in said inlet pipe, means governed by the depth of the oil in said well for controllig one of said valves, and means governed by the temperature of the oil in said well for controlling the other valve.

Condensing Apparatus

No. 1,425,074. Issued on August 8 to Charles L. Buckingham, Denver, Colo., covering a retort furnace and condensing apparatus for the eduction of oil and fuel gas from oil shales and oil sands. In an apparatus of the character described, the combination with supporting walls enclosing a flue span, of a retort U-shaped in cross section, the sides of which terminate in longitudinal flanges which rest on said walls and support said retort, a cover for said retort having a plurality of gas domes, means for feeding material into one end of said retort, an outlet at its opposite end, rotatable means for continuously advancing said material toward said outlet, heating elements in said flue space, and pipes leading from said gas domes.

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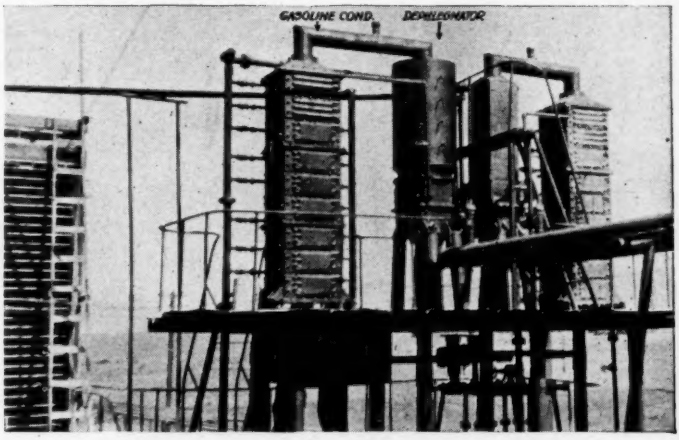
New Condenser Box Has Many Features

The Southwestern Condenser is particularly fitted for handling gasoline or other hydrocarbon vapors from steam stills, fire stills, topping, compression and absorption plants. It is far superior to any of the pipe condensers in general use in refineries. For instance the gasoline condenser is capable of condensing 15,000 to 18,000 gallons in 24 hours, from the still temperature to within 5 degrees of the temperature of the cooling water, has a cross section 2 feet by 2 feet and a height of 7 feet 6 inches, and occupies but a fraction of the space required by the old types.

The standard construction for the body or shell of the Southwestern condensing apparatus is a close-grained cast iron container, designed for durability and strength. The cooling units are made up of short tubes rolled into tube sheets which are integral with the shell in the smaller apparatus.

The return bends are cast in multiple on a plate which bolts on the outside of the tube sheet. By removing a few nuts the tubes for an entire unit are exposed and may be readily cleaned. The relatively high velocity maintained in the tubes prevents liming up of tubes, and keeps the efficiency of the tubes high for a long period of time. With small valves placed between the inlet and outlet pipes and their respective manifolds, units may be closed off one at a time and inspected without shutting down the condenser.

The vertical type has been adopted as standard for all equipment other than air cooling, and in general, the gases, vapors, or liquids to be cooled or condensed enter at the top of the apparatus and flow downward over and outside the horizontal tubes.

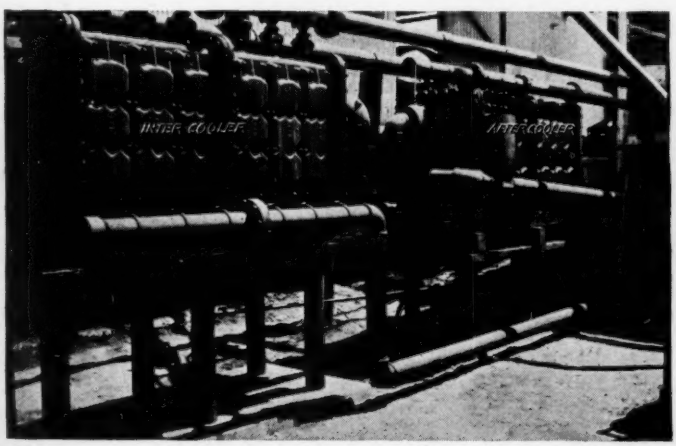


Southwestern Gasoline Condenser

The medium to be cooled first strikes a thin perforated plate and is distributed uniformly over the entire cross section of the shell. For every inch of flow it is deflected and broken up into minute particles due to the high velocity impact up[illegible] the staggered tubes [illegible] mechanical breaking up insures a more intimate contact between the particles being cooled and the cooling surface, and makes the operation very similar to that of the very effective cooling tower. The tubes are staggered. No baffle plates or orifice plates clutter up the interior and give lodgment to carbon. Simply the smooth, rounded surfaces of the tubes themselves divide and deflect the product as it falls downward by gravity. The finished product flows out by gravity in a continuous cool stream or is drawn out by a vacuum pump. When the run is finished the last drop drains from the condenser, leaving the apparatus clean for the next run.

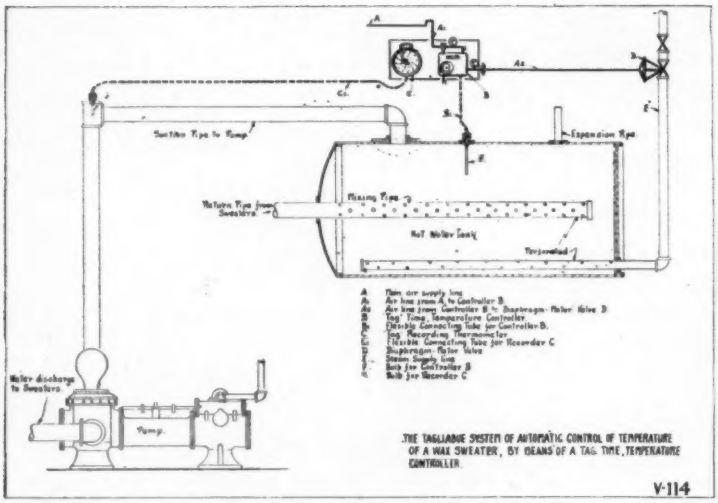
The tubes are grouped in units, each unit having an individual return bond cover plate which is bolted to the tube sheet face. Return bond pockets communicate with the water jacket and provide for circulation of water through the tubes. Carefully machined surfaces and a gasket make a perfect water joint. Three-way valves in the water manifolds by-pass the circulation water when it is necessary to remove slates.

These valves also provide another unique feature. In the three section condenser above mentioned, there are nine units, nine inlet valves and nine outlet valves. It can readily be seen that with this flexible manifolding, a great number of circulating combinations are available. For instance, the valves may be opened straight thru, which puts all nine units in parallel. Such an arrangement is advisable where large quantities of water are available and where the rise in temperature of



Southwestern Heat Exchanger

NOTE—The data carried on this page has no relation to advertising carried in the Refiner and Natural Gasoline Manufacturer. We shall be glad to print short articles on new types of equipment, catalogs, etc., without any obligation on the part of the manufacturer. It is understood, however, that the editorial department, having exclusive charge of this page, has the right to reject or make use of whatever its judgment says is news.



THE TAGLIABUE SYSTEM OF AUTOMATIC CONTROL OF TEMPERATURE OF A WAX SWEATER, BY MEANS OF A TAG TYPE TEMPERATURE CONTROLLER

V-114

It quite often occurs during "sweating" or fractional fusion of wax, (crude scale or slack) that the temperature of the sweating ovens becomes either too low or too high, the former causing a loss of time and the latter a loss of wax.

In order to overcome this fluctuation of temperature in the sweater or pan house, the temperature of the circulating water which heats the house may be automatically controlled by means of a time temperature controller as shown in the accompanying cut.

As the "sweating" progresses the degree of heat is steadily increased until the wax under treatment has reached the proper melting point and appearance. The automatic controller takes care of this increase of temperature by the time attachment and renders the control of proper sweating temperatures a very easy and absolutely accurate matter.

Ingersoll-Rand Company Has New Type Oil Engine

The new Price type PO oil engine which is manufactured by the Ingersoll-Rand Company of New York and recently put on the market is showing very favorable results according to its manufacturers and has been given a cordial reception by the industry.

The engine employs the Price system of fuel injection which eliminates the need for a three or four stage 1000 pound pressure injection air compressor with intercoolers. A pump of single design provides the force for introducing the fuel into the combustion chamber. Two spray nozzles are employed and are so arranged that their sprays impinge. The manufacturer lays great stress on the fact that the head and combustion chamber are shaped so that their surfaces are at all points parallel to the sides of the fuel sprays. The object of this is to prevent the fuel fog from coming in contact with a metallic surface where it would collect as drops and result in imperfect combustion.

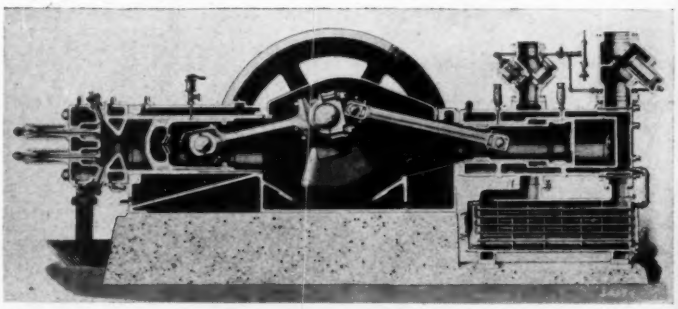
With the Price oil engine, fuel consumptions of .38 or .39 pounds per brake horsepower hour can be gotten with ease it is claimed. The former figure means that twenty horsepower hours can be obtained from a gallon of standard fuel.

Ignition is obtained by the heat of compression. All parts of the head, combustion chamber and cylinder which are exposed to the gases of combustion are water-cooled. No flames, coils or exterior heating devices are required either in starting or during operation.

the cooling water must be held down. When the ratio of cooling water to condensate is 3 or 4 to 1, the condenser is operated most economically when the cold water passes thru the three lower units connected in parallel. It then passes to the center section where it received additional heat from the vapor or liquid, but is still at a temperature below 100 degrees F. and is therefore available as a cooling agent in the top section. It is also perfectly practicable to circulate oil in the top units and transfer the heat ordinarily transferred to the cooling water, to oil that is flowing to the still. This adaption is, of course, of more importance, where the stills are operated continuously, though heat economy may also be of prime importance where it is possible to run semi-continuously, as in plants where the operation may be extended over a period of 24 hours or more.

Oil Coolers and Heat Exchangers

It is generally conceded that oil may be best heated or cooled by dividing it into small streams having a high velocity with a maximum amount of turbulence. It follows then that a tube small in diameer, with a thin wall of high conductivity metal and one that is short and therefore breaks up the core of liquid at frequent intervals, will supply all of these desirable features. This holds true whether we are transferring heat from oil to oil, oil to water, gas to gas or liquid to gas, and it is up to the manufacturer to recommend an installation that will not only do the work specified but will be flexible enough to take care of changing running conditions.



Cross-section of Class P. O. C-2 Price Oil Engine, Compressor Unit, showing intercooler and "Imperial" intake and discharge line unloaders.

The Southwestern Coolers and Exchangers are designed for flexibility of circulation and are so manifolded that practically any desired result may be obtained without structural change in the apparatus. The three-way valves in the manifolds give this flexibility and the multiple units circulate the liquid or gas in parallel or in series, or a combination best suited to get the desired results. And it takes but a moment to do this re-circuiting, or to by-pass a plate so that it may be removed and one small section of tubes exposed for inspection or for cleaning.

Another valuable feature in our construction is the provision for the circulation of two or more independent circuits of like or unlike substances. As an instance, we will take a condition where the problem is to cool a hot oil to as low a point as possible. For economic reasons we wish to save as much of the heat in this oil as is practicable, but the cold oil available is not of sufficient quantity or of low enough temperature to do the entire work. In this case, we have only to circulate the cold oil through that portion of the cooler or exchanger where we have the highest mean temperature. The final cooling may be done by water, cold gas or any other medium of sufficiently low temperature.

REFINERY AND GASOLINE PLANT ACTIVITIES

Government Helium Plant at Fort Worth Will Resume Operation After Repairs

FORT WORTH, TEXAS.—The government helium plant at Fort Worth will start operations again in the near future. This is the only plant of its kind in the world. The capacity of the plant is rated at 30,000 cubic feet of helium per day. Com. Allan G. Olson, U. S. N., is in charge.

Helium is found, associated with nitrogen, in natural gas, probably the gas richest in helium is that found in the locality of Dexter, Kansas, which contains 1.84 per cent. Other sections in Kansas also produce gas with a rich helium content, with smaller amounts in the gas at Petrolia, Texas. The process of helium extraction from natural gas is one of liquefaction by cold and pressure, that is, all constituents are liquefied except the helium and then separated from the latter.

Bull. No. 15, K. C. Testing Lab. gives the properties from natural gas as follows:

Combining weight	1.99
Molecular weight	3.99
Spec. grav. (air=1)	0.1368
Liquefying point	—268.5C
Freezing point	—269.0C
Solubility in cold water	1.487%
Absorption by platinum	great
Weight per cubic foot, lbs. (Air=0.080728)	.01105

The helium content of a natural gas should be at least 0.50 per cent of the gas in order the gas be valuable for extraction purposes.

Lifting Power of Baloon Gases

	Pounds per 1000 cu. ft.	Compared with Hydrogen
Hydrogen	75.138	100.0 %
Helium	69.748	92.84%
Ammonia	33.188	44.16%
Nat. gas (methane)	36.088	48.03%

The presence of helium in natural gas was first discovered by H. P. Cady and D. F. McFarland of the University of Kansas in 1907.

New Concern Organized At Corpus Christi (Tex.)

Corpus Christi, Texas.—The Corpus Christi Refining Company is being organized and will, in the near future start construction on a refinery at Corpus Christi to run Mirando, Panuco, Somerset and Coastal crudes, manufacturing a full line of products therefrom.

The company expects to conduct its business by water, avoiding the payment of high freight rates.

The plan calls for three stills, two gasoline receiving tanks, three agitators, two lube distillate, two finished lube, three lube storage, one kerosene distillate, one kerosene, one finished gasoline, one heavy crude, one light crude, one fuel oil, and the necessary chemical tanks, boiler house, pump house, and warehouse.

Clifford McClellan is president and J. V. Bissonet manager.

Ponca City Refinery To Resume Operation

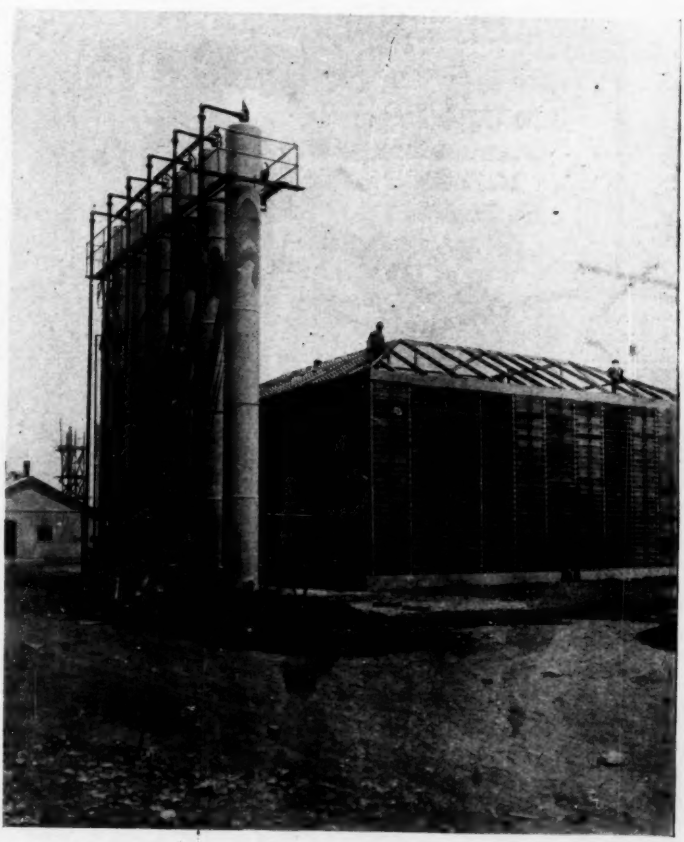
Ponca City, Okla.—When additions and improvements are completed on the plant of the Empire Refineries, Inc., late this month, the refinery will be put back in operation after a shutdown of more than a year, during which the construction has been carried on. In all $1,800,000 is being spent on the Ponca City plant.

The Empire plant at Independence, Kansas, has been moved and combined with the Ponca City refinery. Along with the refinery, the Empire lubricating plant, completed some months back, will be put in operation. Plans are to build a shop for repairing tank cars, as well as a station for the wholesale distribution of oils and a filling station for Ponca City.

The Ponca City refinery of the Empire Company is connected with the Kansas fields by pipe line from Augusta and with the fields of Osage County by another pipe line.

Signal Hill Field to Have Absorption Plant

Long Beach, Cal.—An absorption plant of 10,000,000-foot gas capacity will be erected somewhere adjacent to the Signal Hill area by the Richfield Consolidated and Transport Oil Companies, according to reports this week. A definite site for the plant is being sought now.



The Government's helium plant at Fort Worth, which is preparing to resume operations after some extensive repairs.

Cushing Refinery Now Using Dubbs Process

Cushing, Okla.—The Shaffer Oil and Refining Company's plant here has been enlarged by a four unit Dubbs cracking plant which cost approximately $500,000. The new addition will materially increase the gasoline output of the refinery.

The company is now making preparations for increasing its Cushing storage facilities.

Bristow Plant Will Be Completed by Nov. 1

Tulsa, Okla.—The Transcontinental Oil Company announces that the company's new plant, located at Bristow, Oklahoma, will be completed and put in operation by November 1. The new plant will have a daily capacity of 5000 barrels.

Crude will be supplied by the Transcontinental's holdings in the Bristow fields, a large quantity of which has been stored since the recent price reductions.

With the completion of the Bristow plant the company will have a refining capacity of around 14,000 barrels daily. The company's plant at Boynton, Oklahoma, has a capacity of 3000 barrels and the Fort Worth refinery is capable of running 6000 barrels.

Improvements Increase Capacity of Utah Plant

Salt Lake, Utah—The plant of the Utah Oil Refining Company, subsidiary of the Midwest Refining Company, at this place will be increased from 5000 barrels to 6000 barrels, according to officials of the company.

An expenditure of $600,000 will be made for new equipment including two crude and three high pressure stills which will increase the gasoline output of the plant around 10 per cent.

National Refining Co. Enters Retail Selling Field

Columbus, O.—National Refining Company has entered the retail selling end of hte oil business in Tulsa on a larger scale than ever before with the purchase of the Tulsa Oil Products Company filling station at Thirtieth street and Boston avenue in Tulsa. The National Refining has maintained a curb pump in connection with it but until now has never entered the filling station business in that city.

Marland Refining Co. To Double Storage

Tulsa, Okla.—Information as to refined stocks on hand is given in a recent statement regarding activities of Marland Oil Company which has been made public. The statement indicates that Marland Refining has storage capacity at Ponca City of approximately 2,000,000 barrels and is building additional capacity so as to about double storage facilities.

Marland Refining has in storage some 251,000 barrels of gasoline, 218,000 barrels of kerosene, 319,000 of gas oil and 525,000 of lubricating stock.

Gasoline Finishing Plant To Be Built at Tampico

New York, Aug. 10.—Contract has been let by the Mexican Petroleum Corporation for a $2,000,000 gasoline finishing plant at Tampico, despite the loss of production from salt water in the Toteco-Cerro Azul district.

This addition to the Doheny plant in Mexico will be used in conjunction with the present 120,000 barrel refinery now operated there. The present plant turns out a raw gasoline product. This will be finished as a product ready for commercial use when the new plant is complete. The finishing plant is to have capacity of from 800,000 to 900,000 gallons of gasoline daily.

Separation of Wax From Distillates

Bartlesville, Okla., Sept. 28.—L. D. Wyant, chemical engineer of the Bureau of Mines experiment station at Bartlesville, Oklahoma, is continuing the study of methods of separating wax from Mid-Continent distillates. This is a part of a broader investigation to determine the most efficient methods of preparing lubricating oils from Mid-Continent crudes. Data are being collected on the methods now in use for separating wax from distillates and careful study will be made to determine the nature of the wax that is not removed by pressing. The experimental refinery at the Bartlesville station has been enlarged and will be used for the preparation of wax distillates and lubricating oils from different Mid-Continent crudes.

TULSA BOILER AND SHEET IRON WORKS
ENGINEERS MANUFACTURERS AND ERECTORS
STEEL PLATE CONSTRUCTION
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Box 1926 TULSA, OKLA

PIONEERS IN MID-CONTINENT FIELD
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AGITATORS, COND. BOXES
VAPOR TOWERS AND
ALL OTHER REFINERY
TANKAGE

OIL REFINERY EQUIPMENT

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Agitators Tanks Towers
Walkways and Stairs

Large Stocks of Materials Prevent Delays
Efficient Shop Service

MASHER
STEEL AND MACHINERY COMPANY
DALLAS, TEXAS

Marland Refining Co. Makes Additions to Plant

Ponca City, Okla.—The Marland Refining Company is making an expenditure of $1,600,000 for improvements to its Ponca City plant which when completed will be one of the model plants of the Mid-Continent.

The company's tank farm will be increased by 1,920,000 barrels additional storage space, a complete water works system with a capacity of more than 2,000,000 gallons daily and a complete cracking plant are among some of the new additions being made. The Fleming Process will be used in the cracking plant. The new storage consists of four 80,000 barrel tanks.

When the improvements are complete the plant will have a daily capacity of approximately 14,000 barrels.

Texas Oil Products Co. Operates Model Plant

Waxahachie, Texas.—The Texas Oil Products Company operates a modern refinery at this point. Plant operates new vapor phase cracking process of interest to the technical and practical refiner.

Gasoline is the only product shipped, the residue from the stills is used for plant fuel, and the by-product gas is used locally for heating.

The present capacity of the plant is 1200 barrels of crude per day, which will soon be increased to 6000 barrels.

The plant location is exceptionally well chosen, two railroads and two pipe lines being close to the property.

The company seems to be well organized and financed, the organization being largely composed of technical men.

THE REFINER AND NATURAL GASOLINE MANUFACTURER will have a complete article covering this plant in detail in the next issue.

Imperial Oil Company to Build Plant at Calgary

Toronto, Canada.—According to reports here the Imperial Oil Company, Ltd., subsidiary of the Standard Oil Company, is making arrangements for the construction of a small refinery in the near future at Calgary. The plant will cost approximately $2,500,000.

It is expected that the crude supply at first will be obtained from the Sweetgrass country of Montana, until sufficient production has been built up in the new oil field of northern Canada.

It is planned to have a plant of about 3000 barrels daily capacity.

Interstate Gasoline Co. Takes Over New Era Plant

Wichita Falls, Texas.—The Interstate Gasoline Company has taken over the New Era Refining Company plant at Iowa Park and installed the Greenstreet cracking process.

The plant is expected to run 2000 barrels of Electra crude daily and will be ready for operation by October 15.

Panther Grease Company Ready to Start Operation

Fort Worth, Texas.—The plant of the Panther Grease Company will be ready for operation shortly. A full line of soaps, greases and compounded oils will be made. The daily capacity of the plant will be 10,000 pounds of grease and five cars of oil. Carl Wollner is president of the company and H. C. Dale superintendent.

E. E. Deffenbaugh of the National Rosin Oil & Size Company, Chicago, has just returned to his office after an Eastern trip.

Mr. Deffenbaugh took in the Chemical Show during his trip. He states that it was by far the best exposition of the kind in many years and indicated clearly a great improvement in conditions in the chemical industry.

Empire Company Builds Two Compounding Plants

Tulsa, Okla.—Work on compounding plants being built at Ponca City and Okmulgee refineries of the Empire Refineries, Inc., is being rushed to completion, according to an announcement from the company. The company expects to be distributing oils and greases from the two plants within the next 60 days.

In addition to the compounding plants, canning and barreling facilities are being constructed. Capacity of each plant will be around five carloads per day.

Casper, Wyo.—Construction work on the new refinery of The Texas Company being built here is progressing rapidly. Practically all of the concrete work has been completed and material is now on the ground for storage facilities.

5,000 to 50,000 Rivets

(10 to 100 times the usual number)

Driven by a Single Rivet Set!

There is a reason why ordinary rivet sets break at the shoulder after driving only a few hundred rivets. We discovered this reason and have overcome it by means of a special steel and a novel method of forging and heat-treating same.

KETLER sets regularly drive 5000 to 50,000 rivets each. One set, used in our own structural work, has driven over 100,000 rivets.

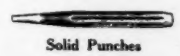
Order a sufficient number by mail to give this set a thorough try-out. If not more than satisfied we will refund your money.

Send for 96-page catalog giving mechanical drawings and dimensions of the complete Ketler-Elliott line of structural, boilermakers' and shipbuilders' highest grade tools, both pneumatic and hand.

Established representatives wanted.

Beading Tools

Chisel Blanks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BUTTON HEAD						CONE HEAD					
No.	Dia. Rivet	Cup Width	Cup Depth	Cup Radius	Price Ea.	No.	Dia. Rivet	Cup Width	Cup Depth	Price Each
3501	3/8	19/32	15/64	5/16	1.50	3551	3/8	21/32	9/32	1.50
3502	7/16	11/16	9/32	23/64	1.50	3552	7/16	3/4	21/64	1.50
3503	1/2	25/32	5/16	13/32	1.50	3553	1/2	7/8	23/64	1.50
3504	9/16	7/8	11/32	29/64	1.50	3554	5/8	1-3/32	15/32	1.50
3505	5/8	1	13/32	33/64	1.50	3555	11/16	1-3/16	33/64	1.50
3506	11/16	1-3/32	7/16	9/16	1.50	3556	3/4	1-5/16	9/16	1.50
3507	3/4	1-3/16	31/64	39/64	1.50	3557	13/16	1-13/32	5/8	1.50
3508	13/16	1-9/32	33/64	21/32	1.50	3558	7/8	1-17/32	21/32	1.50
3509	7/8	1-3/8	35/64	45/64	1.50	3559	15/16	1-5/8	45/64	1.50
3510	15/16	1-15/32	19/32	3/4	1.50	3560	1	1-23/32	47/64	1.75
3511	1	1-19/32	41/64	13/16	1.75	3561	1-1/8	1-27/32	51/64	2.00
3512	1-1/8	1-3/4	45/64	57/64	2.00	3562	1-1/4	1-15/16	53/64	2.25
3513	1-1/4	2	51/64	1-1/32	2.25					

÷ REFINERY SUPPLIES ÷

Sulphuric Acid Shows Signs of Strengthening

Chicago, Ill., Sept. 16.—The chemical market has been rather uneventful during the past month. A number of chemicals used by refiners have varied slightly upward or downward—but as a whole price levels are unchanged.

Sulphuric acid has shown rather pronounced strength. Large quantities have been offered for sale, and a number of consumers are building their own sulphuric acid plants—yet inquiries have been active enough to gradually advance the price, and it is now quoted $1 higher than a month ago, or $10 to $12 a ton.

Caustic soda maintains its strong position and has indeed advanced slightly in price. The demand continues to exceed the normal for this period, stocks in makers hands are reported low, and export demand is active. Makers are said to be turning down long-term contracts, as the outlook is rather uncertain.

Soda chlorate has declined a half cent due to an unexpected reduction of the works price. Demand has been good.

Nitrate of soda also has declined—approximately 10 to 15 cents per hundredweight. Inquiry has been rather quiet, and speculation in this chemical, which for a time was quite active, has ceased.

Acetic acid has shown a price decline of about a half cent, attributable to a number of manufacturers having resumed operations after long shut-downs. Inquiry and buying has been quite satisfactory.

Other chemicals have shown practically no price changes.

Jobbers' Supplies

Animal, fish and vegetable oils have shown little price fluctuation during the month. A few minor price declines, including a rather marked decline in the best grade of Neatsfoot Oil, are due to manufacturers having reduced prices arbitrarily due to lessened cost of production.

The outlook is said to be decidely good, just now. Inquiry is active. The big packers are said to be buying more freely. Castor Oil is firm. Linseed has slightly strengthened in price. Corn oil is moving well, its low price probably being one reason.

Naval stores have shown a considerable price advance during the month. Turpentine has gained a total of about 13 cents, due to a renewal of English buying. Rosins have shown a sympathetic advance. Tar, for many months at $9, has been moving unusually well—stocks have become depleted and prices have advanced sharply. Kiln burned is now quoted at $12.50, while retort is selling at $10.

OIL JOBBERS' SUPPLIES

Prices based on original packages in large quantities, f. o. b. manufacturing points—unless otherwise specified.

Animal, Fish and Vegetable Oils
(Quotations by Falk Company, Chicago)

	Prices Aug. 8	
Lard Oils—		
Prime, bbls., lb.		13¾
Extra Winter Strained, bbls., lb.		11¾
Extra, bbls., lb.		11¼
Extra No. 1, bbls., lb.		10¾
No. 1, bbls lb.		.09¾
No. 2, bbls., lb.		.09¼
Tallow, prime edible, lb.	.07¾	.08
Tallow Oil, acidless, bbls., lb.		.10
Lard Stearine, bbls., lb.	.14¼	.14½
Oleo Stearine, bbls., lb.	.09¾	.09⅞
Neatsfoot Oil—		
Pure, 20 cold test, bbls., lb.		.16
Pure, 30 cold test, bbls., lb.		.14
Extra, bbls., lb.		.10¼
No. 1, bbls., lb.		.09¾
Horse Oil, bbls., lb.		.05½
Red Oil, distilled, bbls., lb.	.09	.09½
English Degras, bbls., lb.	.04¼	.05
Domestic Degras, bbls., lb.	.04¼	.05
Menhaden Fish Oil—		
Light Pressed, bbls., gal.	.54	.55
Yellow Bleached, bbls., gal.	.55	.56
Herring Oil, tanks, coast, gal.	.32	.33
Whale Oil, bleached, bbls., gal.		.75
Sperm Oil, bleached, bbls., gal.	1.62	1.67
Soya Bean Oil pressed, bbls., lb.		.11
Soya Bean Fatty Acids tanks, West, lb.	.09¼	.09¾
Tallow Fatty Acids, bbls., lb.	.06¾	.07
Castor Oil—		
No. 1, bbls., lb.		.13
No. 3, bbls., lb.		.12½
Corn Oil—		
Midle West, tanks, lb.		.06⅞
Cooperage, l. c. l.		.09
Linseed Oil—		
Carloads, bbls., gal.		.88
Less than 5 bbls., gal.	.94	.95

NAVAL STORES

(Quotations by National Rosin Oil & Size Company, Chicago)

Rosins—		
B to I, bbls (280 lbs.)	6.35	6.65
10-20 bbl. lots, f. o. b. shipping point	7.45	7.55
K to WW bbls. (280 lbs).	6.35	8.00
10-20 bbl. lots, f. o. b. shipping point	7.55	9.10
Turpentine, spirits, ex yard gal.		1.29
In drums		1.37
Rosin Oil, first run, gal.		.39
Rosin Oil, second run, gal.		.41
Rosin, Pitch, bbl.		6.00
Tar, kiln burned		12.50
Tar, retort		10.00

REFINERS' SUPPLIES

Prices are based on original packages, in large quantities, and represent spot quotations, unless otherwise stated, f. o. b. manufacturing points.

(Quotations by Wishnick-Trumpeer Chem. Co., Chicago)

Soda Ash, light bags, cwt.	1.75	2.10
Silicate of Soda, 60 deg., tanks, cwt.		1.75
Sal Soda, cwt.	1.20	1.45
Caustic Soda, 76 %, drums, cwt.	3.60	3.75
Chlorate of Soda, kegs, lb.		.06¼
Nitrate of Soda, cwt.		2.40
Potash Permanganate, lb.	.14	.15
Potash Bichromate, sacks, lb.	.10½	.10¾
Sulphuric Acid, 60 deg., tank cars, ton	.10	.12
Acetic Acid—		
28%, bbls., lb.	.02¾	.03
56%, bbls., lb.	.05¼	.05½
80%, bbls., lb.	.08¼	.09
Fullers Earth, 16-30 mesh, carloads, ton	23.00	25.00
Chloride of Lime, cwt.	2.00	2.25
Benzol, pure water white, gal.		.30
Benzol, 90%, gal.		.27
Toluol, gal.	.30	.35

Petroleum Laboratory List Being Compiled

Washington, D. C.—The United States Bureau of Mines is compiling a list of commercial laboratories throughout the country specializing in the analysis of petroleum products. The laboratories are being asked to indicate the particular tests as outlined in Technical paper 298, "Methods of Testing Petroleum Products," which they are prepared to perform.

Special inquiry is being made as to whether laboratories are equipped to make analyses of natural gas as to gasoline content, to examine crude oils, oil shales and oil sands and to undertake petroleum problems of research nature.

Dow Will Continue Work On Oil Field Emulsions

Washington, D. C., Aug. 15.—D. B. Dow, chemical engineer of the petroleum experiment station of the Bureau of Mines, Bartlesville, Oklahoma, is continuing field and laboratory work on the problem of dehydrating oil emulsions. Laboratory investigations have shown that there is a difference in characteristics in ordinary crude oil from the well and oil recovered from emulsions, which indicates that emulsification only affects the heavier and waxy portions of the crude.

The Refiner and Natural Gasoline Manufacturer is the only periodical devoted exclusively to the refining and natural gasoline business. Its subscription price is a dollar a year—your check will do.

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THE idle tank cars in this country are now practically absorbed. In view of the unavoidably slower movement of cars, due to congestion of traffic which is sure to prevail for the next several months, we feel it our duty to impress upon customers the importance of placing orders immediately for the additional tank cars that they will require, in order to protect themselves against the much higher prices and slower deliveries that must ensue.

At this writing, subject to prior sale, we are in a position to make quite prompt deliveries, in reasonable quantities, of our latest improved Class III and Class IV cars of standard capacities.

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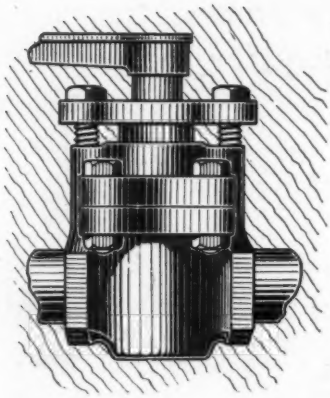
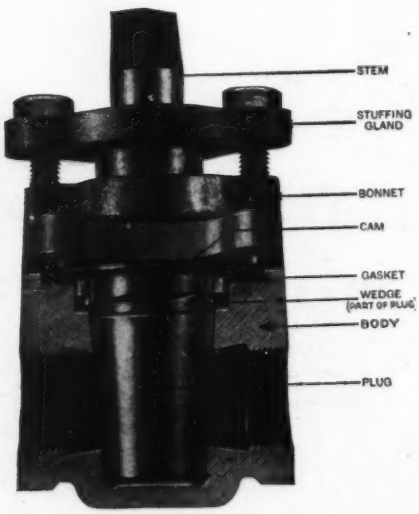
HOMESTEAD
QUARTER-TURN



Quick—
Easy—
Sure—



"Open 'er up!" You grab for the handle, pull — there, it's open! Only a quarter turn, done with the flick of the wrist. No slow, laborious wheel to turn a half dozen times or more.

The stem stays firm—no leaky, wabbling connection. A metal seat at the cam saves the gasket, too.

"Close 'er down!" Back for a short quarter turn; done, and tight! The patented cam forces the plug firmly into the seat.

That's the kind of a valve to use—a **Homestead Quarter-Turn.**

HOVALCO BLOWOFF

HOMESTEAD VALVE MANUFACTURING CO.

VALVES

138 Sixth Avenue **Homestead, Pa., U. S. A.**

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